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DEVELOPMENT TEST II (SERVICE PHASE) OF NIGHT VISION SIGHT, INDIVIDUAL SERVED WEAPONS, AN/PVS-4

FINAL REPORT

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DECEMBER 1974

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15 JAN 1975

SUBJECT: Evaluation of Development Test II (Engineering and Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project Nos. 7-ES-315-SLS-001/002

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1. References.

a. Final Report, Development Test II (Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (US Army Infantry Board), Dec 1974. (Inclosure 1)

b. Second Partial and Final Report, Development Test II (Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (US Army Armor and Engineer Board), 20 Nov 1974. (Inclosure 2)

c. Final Report, Development Test II (Air Portability/Airdrop Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (US Army Airborne, Communications and Electronics Board), Oct 1974. (Inclosure 3)

d. Final Report, Development Test II (Engineering Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-001, Aug 1974.

e. Partial Report, Engineering Test of Night Vision Sight, Small Starlight Scope (Second Generation), AN/PVS-4, TECOM Project No. 7-ES-315-SLS-001, Apr 1973.

f. Partial Report, Service Test of Night Vision Sight, Small Starlight Scope (Second Generation), TECOM Project No. 7-ES-315-SLS-002 (USAIB), Feb 1973.

g. Partial Report, Service Test of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project No. 7-ES-315-SLS-002 (USAARENBD), 21 Feb 1973.

h. Approved Qualitative Materiel Requirement for Individual and Crew Served Weapons Night Vision Sights (CSCRD-64), 2 March 1964.

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SUBJECT: Evaluation of Development Test II (Engineering and Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4, TECOM Project Nos. 7-ES-315-SLS-001/002

2. Approval Statement. The inclosed reports of DT II (Service Phase) and references 1d through 1g previously furnished are approved except as stated herein.

3. Background.

a. The Night Vision Sight, Individual Served Weapons, AN/PVS-4, is a passive image intensification system which uses the low-light-level illumination of the night sky (i.e., starlight, moonlight) reflected from the object and its background to form a clearly defined image. The primary components of the sight are the objective lens assembly, image intensifier tube, tube housing, and the eyepiece assembly. The objective lens assembly's primary function is to focus the light image on the photomissive cathode of the image intensifier tube. It also contains the reticle and its adjustment mechanism used in zeroing the sight to the weapon. The image intensifier tube amplifies the low-light level image and presents a highly intensified image on a phosphor screen. The eyepiece assembly magnifies the resultant image and presents it to the human eye. The eyepiece assembly also contains the necessary adjustments for focusing the sight at various ranges and for correcting the sight picture for the individual variances in the human eye of the various users. The tube housing contains the wiring and housing for the battery-operated power supply. With the exception of the objective lens assembly, all components of the AN/PVS-4 are identical to the components of the Night Vision Sight, Crew Served Weapons, AN/TVS-5.

b. The DT II (Engineering Phase) was initiated on 27 July 1972 at the US Army Aberdeen Proving Ground; DT II (Service Phase) was initiated at the US Army Infantry Board on 26 September 1972; and at the US Army Armor and Engineer Board on 19 October 1972. On 5 January 1973, TECOM suspended testing due to extremely low reliability experienced in the image intensifier tubes. Test agencies were requested to submit partial reports so that TECOM could evaluate whether the tests should be terminated (references 1e through 1g). As a result of the review of the partial reports, 10 equipment deficiencies, 1 maintenance package deficiency, and 17 equipment shortcomings were assessed against the AN/TVS-5 and AN/PVS-4 sights. On 15 March 1973, a meeting was held with representatives of the Night Vision Laboratory to discuss the problems being experienced. As a result of this meeting, it was decided to keep the test in suspension until NVL provided modified test items for DT II (Engineering Phase). Sufficient testing would be conducted at USAAPG to assure that reported deficiencies had been corrected before DT II (Service Phase) would be reinitiated.

c. The DT II (Engineering Phase) was reinitiated at USAAPG on 1 August 1973 and completed on 7 June 1974. The DT II (Service Phase) was reinitiated at the USAIB on 13 May 1974; at the USAARENBD on 30 April 1974; and at the US Army Airborne, Communications and Electronics Board on 25 April 1974. Testing at the USAACEBD was completed on 17 September 1974; at the USAARENBD on 12 August 1974; and at the USAIB on 1 November 1974.

d. All testing was performed in accordance with the approved test plans which were coordinated with USACDC, USAECOM, and USALEA.

4. Test Results.

a. Overall Evaluation.

(1) Of the seven performance characteristics of the QMR, reference 1h, the AN/PVS-4 meets four, partially meets one, and fails to meet two of the requirements. While the item fails to meet the magnification requirement of 4, the actual magnification of 3 is considered to be satisfactory as observers are able to recognize a high percentage of standing man targets from 25 to 400 meters in clear air and starlight and from 25 to 600 meters in clear air and moonlight. The desired requirement for the AN/PVS-4 to be capable of seeing through enemy camouflage is not met. Environmental engineering tests indicate that the sight should perform satisfactorily in all climatic categories of AR 70-38 except category 8, extreme cold.

(2) Of 16 essential physical characteristics of the QMR, 11 are met, two are partially met and three are not met. While the length requirement of 11 inches is not met, the actual length of 11.7 inches is considered to be satisfactory. Although the sight fails to meet the fungus requirement of the QMR due to fungus forming on the web strap of the carrying case and eyepiece of the sight during engineering tests, this failure should not have a serious effect on the performance of the sight. While the image intensifier tubes meet the sensor life requirements of the QMR of at least 1,000 hours, the AN/PVS-4 fails to meet the mean-time-between-failure requirement of the QMR of 1,000 operating hours (see paragraph 4g below). Mounting brackets provided are satisfactory with the exception of the deficiency cited in paragraph 4b(2) below and the shortcomings cited in paragraphs 3 through 5 of Inclosure 4. Reticle patterns provided are satisfactory except for the shortcomings cited in paragraphs 1, 2 and 11 of Inclosure 4. Even though the deficiency and shortcomings exist, the AN/PVS-4 provides an effective night sighting device for all weapons with which it is intended to be used, except the M16A1/M203 weapon system.

(3) The sight meets all maintenance and human engineering characteristic requirements of the QMR. However, changes are necessary in the maintenance test package to make it acceptable.

(4) Performance of the AN/PVS-4 is equal to or exceeds that of the AN/PVS-2B (product-improved 1st generation) except in the area of reliability. However, the reliability of the AN/PVS-4 is higher than that demonstrated by the AN/PVS-2 during the same stage of development (i.e., during ET/ST). The AN/PVS-4 was preferred over the AN/PVS-2B by the majority of the users when used either in the hand-held mode for tactical observation or as a weapon sight.

b. Deficiencies (5).

(1) The maintenance test package is inadequate for the following reasons:

(a) The technical manuals contain incorrect, incomplete and unclear instructions (Paragraphs 1.3.1 and 2.2, Appendix C, Inclosure 2, and Paragraph 2.7, Inclosure 1).

(b) The proper MOS for performance of organizational maintenance in Armor units is not designated (Paragraph 1.3.2, Appendix C, Inclosure 2).

(2) The range indicators of the M16/M203 combination weapon are not correlated in the aiming system. The M203 adapter bracket range scale is not properly calibrated with the grenade aiming point on the M16A1 reticle. If the sight is zeroed to the M203 grenade launcher the reticle does not provide an accurate aiming point for the M16A1 rifle and vice versa. Deficiency paragraph 1.1 and Shortcoming 2.4 of Appendix C, Inclosure 1 and Shortcoming paragraph 2.8, Appendix C, Reference 1d have been combined into this single deficiency.

(3) The three following equipment deficiencies are considered to be the major contributors to the failures which resulted in the reliability and durability deficiency being assessed against the sight by the USAIB in paragraph 2.9.5.5 of Inclosure 1.

(a) The method of bonding the eyeguard to the eyeguard retaining ring is inadequate. When the eyeguard separates from the retaining ring the sight cannot be used either for weapon firing, since the operator no longer has eye protection from weapon recoil, or for tactical observation, as security from detection is lost. Deficiency paragraph 1.2, Appendix C, Inclosure 1 and Paragraph 1.1, Appendix C, Reference 2 have been combined into this single deficiency.

(b) The method employed in wiring the image intensifier tube to the housing is inadequate. As a result, the fine wires used are easily damaged during assembly, maintenance, or use causing failures of the sight. Shortcoming 2.18, Appendix C, Reference 1d has been reclassified to this deficiency.

(c) The epoxy compound used in manufacturing of the image intensifier tube does not adequately moisture proof the tube. Moisture enters the multiplier causing the tube to shut off. This is an added deficiency resulting from NVL's analysis of image tube failures.

c. Shortcomings (11). See Inclosure 4

d. Declassifications (9).

(1) Paragraph 2.8, Appendix C, of Inclosure 1 reports as a shortcoming that the sight does not permit rapid and positive identification of defective or malfunctioning components. The maintenance charts indicate that the maximum time to diagnose the cause of any of the 18 failures is 0.2 hours. This maximum diagnostic time of 12 minutes, which includes time to disassemble the sight, is considered to have met the requirement for which there is no specified time. This shortcoming is declassified and is reported for information only.

(2) Paragraph 2.3, Appendix C of Inclosure 2 reports as a shortcoming that the design of the locking knob for the mounting bracket is such that it cannot be secured to the bracket; thus, it falls out of the bracket. Paragraph 2.8.5.7, Inclosure 2 indicates that this did not occur during 2,072.5 hours of testing and that periodic knob tightening by the operator will keep the sight firmly affixed to the bracket. This shortcoming is declassified and is reported for information only.

(3) Paragraph 2.1, Appendix C of Reference 1d reports as a shortcoming that storage containers are not supplied for the weapon-adapter brackets M60, M79, M67, M72A1 and M16 with M203. The agencies conducting the DT II (Service Phase) had no problem storing or transporting these brackets when not attached to the weapon and did not consider the absence of a storage container to be a shortcoming. The shortcoming is declassified and is presented for information only.

(4) Paragraph 2.2, Appendix C of Reference 1d reported as a shortcoming that the angular resolution of 1.3 lp/mr at 10^{-3} foot-candles is inadequate for night viewing. However, users were able to recognize a high percentage of standing man targets at ranges of 25 to 400 meters in clear air under starlight conditions and 25 to 600 meters in clear air under moonlight conditions as required by the QMR. The shortcoming is declassified and is presented for information only.

(5) Paragraph 2.6, Appendix C of Reference 1d reported as a shortcoming that the M72 adapter bracket interfered with the action of the arm-safe pull lever. The brackets for the M72 were modified by NVL prior to being furnished for DT II (Service Phase). This problem was not experienced during the DT II (Service Phase) and, therefore, this shortcoming is considered a corrected shortcoming and is declassified and presented for information only.

(6) Paragraph 2.10, Appendix C of Reference 1d reports as a shortcoming that the shipping case liners are not pliable and prevent repacking of the sight in the case at all temperatures below -25°F. The NVL has redesigned the interior openings of the case to provide sufficient clearances. The shortcoming is declassified and is presented for information only.

(7) Paragraph 2.13, Appendix C of Reference 1d reports as a shortcoming that the eyeguard ring freezes to the sight at -25°F and prevents access to the demist lens. Due to its high cost and limited usefulness, the demist lens has been eliminated and this is no longer a problem. The shortcoming is declassified and is presented for information only.

(8) Paragraph 2.14, Appendix C of Reference 1d reports as a shortcoming that the variable diopter ring freezes to the sight at -65°F and prevents lens adjustment of the sight to the eye characteristics of the operator. The sight will be stored in areas where temperatures are well above -65°F and the user will normally adjust the diopter setting upon being issued the sight. This shortcoming is declassified and is presented for information only.

(9) Paragraph 2.17, Appendix C of Reference 1d reports as a shortcoming that the weapon-adapter brackets are susceptible to humidity damage. During humidity tests some of the screws, wing nuts, and washers used on various brackets rusted. This rusting can be prevented by application of oil and proper maintenance. This shortcoming is declassified and is presented for information only.

e. Safety. Other than the safety problems associated with the deficiency, paragraph 4b(3)(a) and the shortcoming, paragraph 7, Inclosure 4, there are no safety problems associated with use or maintenance of the sight.

f. Maintenance/Maintainability. The design for maintainability of the sight is adequate except for the method of wiring the image intensifier tube to the housing (Deficiency paragraph 4b(3)(b) above). Combining maintenance data from the USAIB, USAARENBD, and USAAPG, the AN/PVS-4 demonstrated a Maintenance Ratio (MR) of 0.0024 and an Achieved Availability (Aa) of 0.9976. The maintenance test package is inadequate (Deficiency 4b(1) above).

g. Reliability.

(1) Test Criteria from the QMR, reference 1h, are as follows:

(a) Normal combat life of this item (mean-time-between-failure not including operator maintenance requirements) will be 1,000 operating hours, 2,000 operating hours (desirable).

(b) Sensor life will be at least 1,000 hours, 2,000 hours (desirable).

(2) AN/PVS-4

(a) During DT II testing of the AN/PVS-4 at the USAAPG, USAARENBD, and the USAIB there was a total of 13,721 hours of sight operation with 22 chargeable system failures occurring. Based on an exponential failure distribution, the point estimate of MTBF was 624 hours. The two-sided 80 percent confidence-interval estimate provides an upper-limit MTBF of no higher than 845 hours and a lower-limit MTBF of at least 468 hours.

(b) Of the 22 chargeable system failures, the 5 eyeguard, 2 broken wires and 4 of the image intensifier tube failures, due to the moisture entering the tube as a result of improper potting material being used, are associated with the deficiencies cited in paragraphs 4b(3)(a), 4b(3)(b) and 4b(3)(c) above. The Night Vision Laboratory has instituted changes in the manufacturing techniques of the image intensifier tubes. This should eliminate 2 failures due to insufficient scrubbing of the microchannel plate and 2 failures due to gas leaks in the image intensifier tubes which caused shorts. Assuming that modifications made to correct the deficiencies and manufacturing techniques of the image intensifier tubes are successful, the point estimate of MTBF based on 13,720 hours of sight operation and the 7 remaining uncorrected failures is 1,960 hours.

(3) Image Intensifier Tubes

(a) During testing of the AN/TVS-5 and AN/PVS-4 at the USAAPG, USAARENBD, and the USAIB a total of 42 tubes were subjected to 20,992 hours of testing with 14 failures occurring. An analysis was conducted to determine the failure distribution of the image intensifier tubes. The distribution of failure times was determined to be Weibull from Nelson's method of Hazard Plotting for Incomplete Failure Data. Using graphical methods, it is estimated that of the tubes under test, 54 percent would have failed before 1,000 hours and that the mean life of the tubes under test is estimated to be 1,472 hours.

(b) Of the 14 tube failures, 11 were associated with the same types of failures discussed in paragraph 4g(2)(b) above. Assuming correction of these failures, the point estimate of MTBF for the image intensifier tubes based on 20,992 hours of operation and 3 failures should be 6,997 hours. This is not to predict that tube life will be as high as the MTBF.

5. Comments.

a. With regard to the deficiency, paragraph 4b(3)(a) above, the NVL provided modified eyeguards to the USAIB for evaluation during testing of the AN/TVS-5. While the modification was not considered to be completely adequate, it did prevent the sudden loss of an eyeguard from making the sight unusable. The modification, together with periodic inspection of eyeguards and replacement of those which are damaged to the point where they might be lost, will eliminate this deficiency. The manuals should be modified to indicate that the monthly preventive maintenance check include inspection of the eyeguard and replacement if necessary.

b. With regard to the deficiency, paragraph 4b(3)(b) above, all 1st generation night vision sight tubes are constructed so that power supply and grounding connections to the housing are made through pin/socket connections. This type of connection has proven to be completely satisfactory during all testing conducted by TECOM. Modification of the image intensifier tube wiring system to pin/socket type connections should eliminate the failures.

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c. DT II (Environmental Phase) is scheduled for conduct during 2d and 3d Quarter FY 75 and 1st Quarter FY 76. Modifications required to correct deficiencies and shortcomings should be made to the equipment prior to test items being furnished for testing. This will permit testing of modifications to determine adequacy prior to full-scale production.

6. Conclusions.

a, The operational capabilities of the Night Vision Sight, Individual Served Weapons, AN/PVS-4 equal or exceed those of the Night Vision Sight, Individual Served Weapons, AN/PVS-2B.

b. Correction of the deficiencies and shortcomings should increase the reliability of the AN/PVS-4 to the QMR requirements.

7. Recommendation. The deficiencies and as many as feasible of the shortcomings be corrected and verified by TECOM during DT II (Environmental Phase) and DT III of the Night Vision Sight, Individual Served Weapons, AN/PVS-4.

FOR THE COMMANDER:

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4 Incls
1. USAIB Final Report - 7-ES-315-SLS-002
2. USAARENBD Second Part & Final Report - 7-ES-315-SLS-002
3. USAACEBD Final Report - 7-ES-315-SLS-002
4. Shortcomings

SHORTCOMINGS

1. The reticle pattern for the M16A1, M14, and M60 weapons requires the user to estimate ranges except at 400 and 600 meters. At ranges less than 400 meters the user is confused as to where on the pattern to sight, which reduces hit probability. Shortcomings 2.3, Appendix C, Reference 1d and 2.6, Appendix C, Inclosure 1 have been combined into this single shortcoming.

2. All reticle patterns provided are not plumb and cannot be adjusted by the operator. This results in inaccuracy of the weapon/sight combination at all ranges other than the range at which the weapon/sight has been zeroed (Paragraph 2.5.5, Reference 1d).

3. The range marks on the M79 launcher adapter bracket are inaccurate for some ranges. This reduces the hit probability at ranges other than the range at which the weapon/sight combination is zeroed (Paragraph 2.5.5, Reference 1d).

4. The M72 launcher bracket/reticle combination does not properly compensate for temperature effect on the M72 missile. This results in a lower firing accuracy when temperatures change significantly between the time the weapon/sight combination is zeroed and the time when the sight is used to fire the weapon (Paragraph 2.5.5, Reference 1d).

5. The M60 machine gun bracket does not maintain sight zero and is difficult to mount. As a result of cross-country travel with the sight mounted on the M60 machine gun on the M114 vehicle, mounting and remounting operations on the M60 machine gun used by Infantry squads, or as a result of weapons firing, there is a shift in zero of the sight resulting in decrease in hit probability. Shortcomings reported in Paragraph 2.5.5, Reference 1d; Paragraphs 2.6.5.1a and 2.11.5.5b, Inclosure 1; and the deficiency reported in Paragraph 2.4.5.3, Inclosure 2 have been combined into this single shortcoming.

6. The material used in the carrying case loses it pliability at temperatures below -25°F (Paragraph 2.7.5, Reference 1d). In climatic areas where temperatures occur below -25°F, the carrying case freezes. If this occurs when the carrying case is in a collapsed condition, it cannot be used to carry the sight.

7. The eyeguard material freezes at -65°F (Paragraph 2.7.5, Reference 1d). In the frozen condition, the eyeguard loses weapon-recoil protection.

8. The insulation of the low-temperature adapter cable cracks and loses its insulative properties during use at -65°F (Paragraph 2.7.5, Reference 1d). This could result in loss of power to the sight.

9. The eyeguard and carrying case straps are not adequately treated for fungus resistance (Paragraph 2.11.5, Reference 1d). During fungus test there was fungus growth on the eyeguard and web straps of the carrying case.

10. The daylight cover does not provide sufficient variations of openings to permit zeroing of the weapon/sight combination during all light conditions. As a result, either the reticle pattern or the target is difficult to see in bright daylight, bright moonlight, heavy overcast daylight or at dawn and dusk, which prevents zeroing operations. Shortcomings Paragraphs 2.6.5.2d, Inclosure 1 and 2.4.5.4, Inclosure 2 have been combined into this single shortcoming.

11. The one reticle provided for use when the sight is mounted on the M16A1, M14, M60 and M79, and M203 brackets is confusing to the user. The reticle picture contains so much information that the user is easily confused as to what sighting point he should use with which weapon thus reducing hit probability (Paragraph 2.6.5.2b, Inclosure 1)

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Night Vision Sight, Individual Served Weapons, AN/PVS-4

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Development Test II (Service Phase) of Night Vision Sight, Individual Served Weapons, AN/PVS-4 (Second Generation) was conducted by the US Army Infantry Board at Fort Benning, Georgia, from 26 September 1972 to 1 November 1974. The purpose of the test was to determine to what degree the test item met the requirements of the Qualitative Materiel Requirement (QMR), and to confirm the safety release. Ten test sights were received. Test soldiers were from an Infantry TOE unit. Testing was suspended on 5 January 1973 due to repeated failures of the image intensifier tube. A partial report was

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20. ABSTRACT (Continued)

submitted in February 1973. Testing was resumed on 13 May 1974 with modified test sights. The previously conducted testing that was affected by the modifications was repeated.

It was concluded that:

a. The test sight, sight brackets, and components fail to meet six of the QMR requirements and one USAIB stated requirement prescribed for its development.

b. The test sight, sight brackets, and components offer improvement over the control sight, with respect to weight, size, firing accuracy, and troop acceptance; both sights are comparable for observation capabilities.

c. The test sight, sight brackets, and components are safe for US Army use.

d. The combined reticle pattern for the M16A1, M14, M60, M79, and M203 and the daylight cover for the sight possess design characteristics that hinder the usability and effectiveness of the weapon/sight combinations.

e. The test sight is not sufficiently durable or reliable to withstand the rough handling associated with normal operations.

It was recommended that the test sight, brackets, and components be modified to correct the defects noted during testing.

SUMMARY

RESULTS

The Night Vision Sight, Individual Served Weapons, AN/PVS-4 (Second Generation), was tested against a total of 45 requirements, of which 38 were met. The seven criteria not met resulted in two deficiencies and eight shortcomings.

All test equipment arrived in good condition, was functional, and all components were compatible. The mean weight of the AN/PVS-4 sight with batteries is 4 lb .50 oz. It is 12-5/8 inches long and 4-15/32 inches in diameter. This is 2 lb 8.5 oz lighter and 5-1/16 inches shorter than the AN/PVS-2B (para 2.1.4.3).

Three reticle patterns were provided: one for the M14, M16A1, M60, M16A1/M203 and M79; one for the M67; and one for the M72A2. The first pattern clutters the screen, provides extraneous information as to ranging capabilities, and has range marking dots the soldier does not need or seldom uses (para 2.6.5.2e).

On open flat terrain and in clear air, the AN/PVS-4 sight provided recognition of a single standing man out to 600 meters under moonlight conditions and out to 400 meters under starlight conditions (para 2.4.5.1). The AN/PVS-2B provided comparable recognition capabilities.

The AN/PVS-4 is completely passive and will not interfere with any communications or surveillance equipment (para 2.5.5; also para 2.5.5.1, Partial Report (ref 9, app F)).

The AN/PVS-4 gives an Infantryman a night fire capability approximating that provided by the standard daylight sights with the M14 and M16A1 rifles, the M60 machine gun, the M79 grenade launcher, the M67 recoilless rifle, and the M72A2 Light Antitank Weapon (LAW). Because of design problems, the M203 grenade launcher/sight combination does not provide this capability (para 2.7.5.9).

The AN/PVS-4 sight provided a night fire capability with the M16A1 rifle, under both moonlight and starlight conditions, that was significantly better than with the AN/PVS-2B sight (para 2.7.5.2).

Except for the rubber eye shield separating from the test sight, no unsafe characteristics or safety hazards were noted with the AN/PVS-4 (para 2.2.5).

Upon completion of the training program, the test soldiers were sufficiently trained to insure proper use and to maintain the AN/PVS-4 in a safe manner (para 2.3.5.2).

Except for the M60 machine gun, the test soldiers did not experience any difficulty mounting the test brackets to the respective weapons (para 2.6.5.1a). The M60 would not retain its zero due to the configuration of the mounting bracket assembly and its interface with the M60 machine gun feed tray cover. The cover does not provide adequate stability to retain zero for the test item (para 2.6.5.1a and 2.6.4.7).

The M203 bracket range scale is not properly graduated (para 2.6.5.1b).

All zeroing procedures were essentially the same as for the daylight sights; however, the M203/M16A1 zeroing procedures were inadequate, as they did not permit the firer to use the M203 grenade launcher-sight combination with the M16A1 weapon-sight combination (para 2.6.5.3b).

All sights retained their zero during all phases of transportability and portability (para 2.8.5.4).

There were 17 durability/reliability failures: five image intensifier tube failures, two defective objective lens, four eyeguard body separations, two broken terminal wires on the tube brightness control, one defective illuminator assembly, one defective reticle cell, and two defective tube brightness controls (para 2.9.5.2).

The MTBF for the AN/PVS-4 was 340 hours.

Mean battery life for the AN/PVS-4 was 32 hours (para 2.9.4.5).

The sight does not permit rapid and positive identification of defective components. However, the DS repairmen were able to identify defective components with no difficulty by exchanging components (para 2.10.4.5c).

A maintenance package was furnished consisting of the necessary equipment publications, repair parts, and tool kits (para 2.1.4.8).

The AN/PVS-4 is man-portable and can easily be transported in Army vehicles or aircraft (para 2.8.5.1 and 2.8.5.2).

The AN/PVS-4 generally was designed in accordance with good human factors engineering. Test soldiers preferred to use the test item rather than the control item (para 2.11.5.1).

The deficiencies and shortcomings were:

a. Deficiencies:

(1) The grenadier using the test sight mounted on the M203 grenade launcher is not able to use the sight in conjunction with the M16A1 rifle for close-in protection (para 2.6.5.3b).

(2) The test item lacks sufficient durability and reliability (para 2.9.5.5c).

b. Shortcomings:

(1) The illuminated sight reticle is difficult to see in bright daylight, heavy overcast, dusk, dawn, and bright moonlight (para 2.6.5.2d).

(2) The M60 machine gun mounting bracket is difficult to mount (para 2.11.5.5b).

(3) The M60 test sight combination loses its zero after the first dismounting (para 2.6.5.1a).

(4) The M203 adapter bracket range scale is not properly graduated (para 2.6.5.1b).

(5) The reticle sight picture is different than that of the daylight sights of the M16A1, M14, M60, M79, and M203 (para 2.6.5.2b).

(6) The ranging dots in the reticle pattern for the M16A1, M14, and M60 require the firer to estimate ranges between 50 and 400 meters (para 2.6.5.2c).

(7) The draft technical manuals are not accurate and consistent within each other. The DTM's dealing with repair parts are poorly organized, making identification difficult (para 2.10.3.5b).

(8) The sight does not permit rapid and positive identification of malfunctioning parts or defective components (para 2.10.4.5c and 2.10.5.5b).

CONCLUSIONS

The US Army Infantry Board concludes that:

a. The test sight, sight brackets, and components fail to meet six of the Qualitative Materiel Requirements and one USAIB stated requirement prescribed for its development.

b. The test sight, sight brackets, and components offer improvement over the control sight with respect to weight, size, firing accuracy, and troop acceptance; both sights are comparable for observation capabilities.

c. The test sight, sight brackets, and components are safe for US Army use.

d. The combined reticle pattern for the M16A1, M14, M60, M79, and M203 and the daylight cover for the sight possess design characteristics that hinder the usability and effectiveness of the weapon/sight combinations.

e. The test sight is not sufficiently durable or reliable to withstand the rough handling associated with normal operations.

RECOMMENDATIONS

The US Army Infantry Board recommends that the Night Vision Sight, Individual Served Weapons, AN/PVS-4, brackets and components be modified to correct the deficiencies and as many of the shortcomings as feasible, and to implement the suggested corrective actions.

FOREWORD

The US Army Infantry Board was responsible for test planning, test execution, and test reporting.

TABLE OF CONTENTS

SECTION 1 - INTRODUCTION

1.1 Background.

1.1.1 A description of the development and testing of the first generation night sight is contained in reference 9, Appendix F.

1.1.2 The second generation starlight scope was developed to meet those requirements not met by the first generation types. This starlight scope, designated the Night Vision Sight, Individual Served Weapons, AN/PVS-4, was submitted for a service test in September 1972. The US Army Test and Evaluation Command (TECOM) directed that the US Army Infantry Board (USAIB) conduct a service test of the second generation sights for Infantry use and serve as monitoring agency for certain phases conducted by the US Army Armor and Engineering Board (USAARENBD) and the US Army Airborne, Communications, and Electronics Board (USACEBD). Upon successful completion of the service test, a desert service test is to be conducted. Tropic and arctic tests are to be conducted by the US Army Tropic Test Center and US Army Arctic Test Center, respectively. The engineering test was conducted by Materiel Test Directorate, Aberdeen Proving Ground (APG).

1.1.3 Service testing of the second generation starlight scope was initiated on 26 September 1972. On 21 December 1972, based on recommendations by USAIB, testing was suspended by TECOM due to a lack of reliability of the image intensifier assemblies. A Partial Report, submitted in February 1973, reported 10 deficiencies and 13 shortcomings. A summary of the Partial Report follows:

1.1.3.1 The Night Vision Sight, Individual Served Weapons, AN/PVS-4, was tested against 38 requirements.

a. Sixteen were met.

b. Seven were met to the extent tested.

c. Four were partially met.

d. Seven were not met.

e. Four were not tested sufficiently to permit analysis.

1.1.3.2 The deficiencies were:

a. The method by which the rubber eye shield is attached to the sight is not sufficiently durable.

b. The range graduations on the M72 reticle pattern do not correspond to the range graduations on the standard daylight sight.

c. The illuminated sight reticle is not suitable. The operator cannot increase the reticle brightness sufficiently to make the reticle pattern clearly distinguishable under all light conditions.

d. The image intensifier assembly is not sufficiently durable to withstand the shock of repeated firing.

e. The test sight lacks the essential durability to withstand the rough handling associated with normal operations.

f. There are 41 screws on the external surface of the sight indicating poor design.

g. The sight reticle and its adjusting mechanism are not reliable.

h. The draft technical manuals do not comply with military standards.

i. The test sight is difficult to maintain.

j. Adjustment of the azimuth and elevation adjustment mechanism is not audible or tactile in a normal operating environment.

1.1.3.3 The shortcomings were:

a. Testing and calibration equipment is not built into the system.

b. The test sight is passive; however, it can be detected at night by personnel equipped with an active infrared light source and viewing device. The light is reflected by the objective lens of the test sight and detected by the observer using the viewing device.

c. The M203 bracket locking knob would not secure the bracket on the selected range graduation. The self-clinching stud on the locking knob turned freely; consequently, the plate on which the index mark is scribed shifted on the range scale plate.

d. The sight brackets for the M60, M72, M79, and M203 are big, bulky, and add significantly to the weight of the weapon.

e. The grenadier using the test sight mounted on the M203 is not able to use the sight in conjunction with the M16A1 for close-in protection.

f. Twenty rounds of ammunition must be fired to stabilize the sight reticle prior to zeroing the M16/M16A1 weapon-sight combinations. This requirement causes an excessive amount of ammunition to be expended.

g. The Allen wrench used to secure the sight to the M14 bracket is too short for its intended purpose.

h. There is no suitable tool for making accurate sight setting adjustments.

i. The illuminated reticle burns the phosphor screen on the image intensifier assembly.

j. The threads on the range focusing ring are not adequate. The ring frequently sticks and binds.

k. The sight is not designed for rapid and positive identification of defective components.

l. The design of the sight does not take into consideration the physical characteristics of the repairman who must maintain it.

m. The amount of adjustment permitted by the design of the range focusing ring is excessive.

1.1.3.4 The test sight met the criteria specified in applicable requirements documents with respect to the following major areas of performance:

a. The sight, when used in the hand-held role, enables operators to recognize a standing man at ranges of 25 to 400 meters in clear air and starlight and 25 to 600 meters in clear air and moonlight.

b. When used as a weapon sight under ambient light conditions approximating moonlight, it enables firers to engage targets effectively at ranges of 50 to 300 meters.

The demonstrated performance of the test sight as a hand-held observation device and as a weapon sight was comparable to the demonstrated performance of the control sight (AN/PVS-2B).

1.1.3.5 The test sight incorporates several new or improved features. Collectively, they represented a significant improvement over the control sight and greatly enhanced overall troop acceptability, e.g., smaller size, lighter weight, rifle mounting position, wider field of view, improved balance, brighter viewing screen, and the illuminated reticle. One additional improvement of the test sight over the control sight was the distance at which it could be zeroed to the individual weapon. The test sight is zeroed at 25 meters; the control sight is zeroed at 150 meters.

1.1.3.6 The rubber eye shield separates from the test sight frequently. This impacts on the safety of the test item in that a soldier attempting to fire a weapon-sight combination without the rubber eye shield in position could suffer head or eye injury. This is considered a marginal safety hazard. No other unsafe conditions or safety hazards associated with the employment of the sight were noted. Soldiers using the sight are protected from flash and glare, and there is no internal or external radiation safety hazard associated with their employment.

1.1.3.7 Instruction outlined in current training circulars pertaining to the first generation starlight scope is adequate to train personnel sufficiently to use the test item either as a weapon sight or as a hand-held observation device.

1.1.3.8 The test sight did not meet the criteria specified in applicable requirements documents with respect to reliability and durability. The test sight demonstrated a MTBF of 45 hours and the image intensifier assembly a MTBF of 92 hours. Components of the sight most seriously lacking in durability are: image intensifier assemblies, reticle retaining rings, eyeguard retaining nuts, demist disks, reticle cells, and battery cap threads.

1.1.3.9 The test sight is not designed to facilitate maintenance, nor does it incorporate good maintainability design features.

1.1.3.10 The test sight is designed in accordance with good human factors engineering.

1.1.4 Upon suspension of testing, all test items were returned to Night Vision Laboratory (NVL) for additional development to correct all deficiencies and as many shortcomings as feasible.

1.1.5 During the period February 1973 to May 1974, further product improvements were made on the second generation sights.

1.1.6 During suspension of testing, USAIB was relieved as monitoring agency, and the title of the test was changed from service test to Development Test II (Service Phase).

1.1.7 Testing was resumed by USAIB on 13 May 1974.

1.2 Description of Materiel.

1.2.1 The Night Vision Sight, Individual Served Weapons, AN/PVS-4 (hereinafter referred to as the test item or test sight), is a portable,

battery-operated, electro-optical instrument used for observation and aimed fire of weapons at night. It uses the low light level illumination of the night sky, i.e., starlight, moonlight, reflected from the object and its background to form an erect, clearly defined image. The sight can be mounted on the M14 and M16A1 rifles (M14, M16A1), M60 machine gun (M60), M67 recoilless rifle (M67), M72A1/A2 rocket launcher (M72), and M79 and M203 grenade launchers (M79, M203). The sight is passive in nature. The sight consists of the main housing, objective lens assembly, range focusing ring, illuminated sight reticle (fig A-22 through A-24, Part I, app A) with azimuth and elevation adjustment knobs, eyepiece assembly with rubber eye shield, and eyepiece diopter focusing ring, image intensifier assembly, and an objective lens daylight cover. The sight has controls for increasing or decreasing the brightness of the reticle and the image intensifier assembly. (See fig 1.)

1.2.2 The physical characteristics of the test sight are:

a. Weight - 4 pounds, .50 ounce (with batteries and lens cover)

b. Length - 12-5/8 inches (with daylight cover)

c. Diameter - 4-15/32 inches

d. Magnification - 3.8X

e. Field of view - 14.5 degrees

f. Eyepiece focus - $\pm$ 4.0 diopters

g. Objective lens focus - 25.0 meters to infinity

h. Reticle adjustment - $\pm$ 4 degrees (in 1/4-mil increments)

i. Battery pack type - BA 1567 ( )/U

1.2.3 The primary component of the sight is the image intensifier assembly. It operates in such a manner that a light image focused on a photomissive cathode by an objective lens causes the emission of electrons in direct proportion to the light energy falling on each unit area of the cathode. The electrons are accelerated and focused by the high voltage electro optical system and travel through the microchannel plate that multiplies the electrons, which then impinge on a phosphor screen, providing a highly intensified image of the initial low light level image falling on the cathode. The eyepiece magnifies the resultant image and

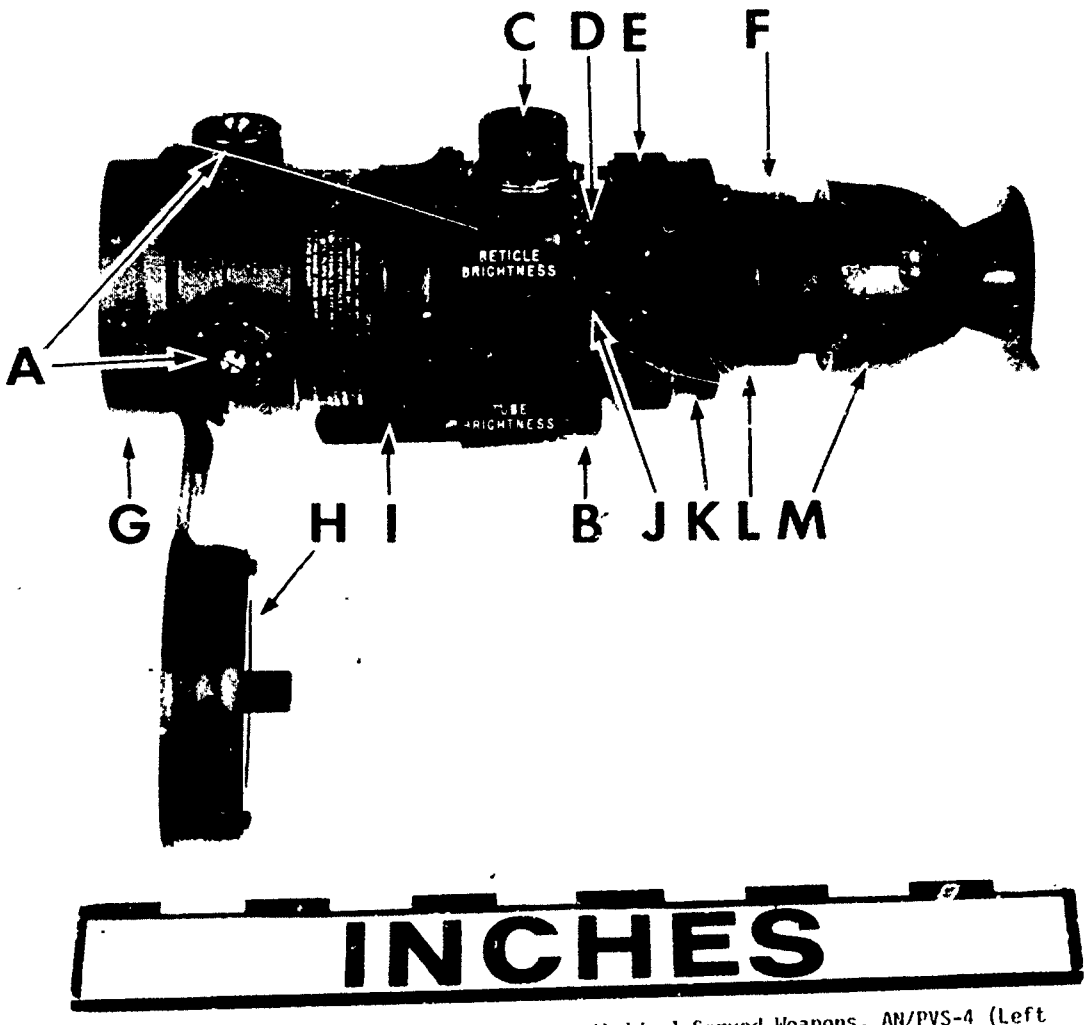


Figure 1. Night Vision Sight, Individual Served Weapons, AN/PVS-4 (Left View)

LEGEND

A - Reticle Elevation Adjustment Control and Reticle Azimuth Adjustment Control
B - On-Off Tube Brightness Knob
C - Battery Retainer
D - Reticle Brightness Knob
E - Range Adjustment Ring
F - Diopter Focusing Ring
G - Objective Lens Assembly, 95-mm
H - Daylight Cover
I - Mounting Bracket Adaptor
J - Housing Assembly
K - Retaining Ring Rear and Limit Stop Ring
L - Diopter Scale
M - Eyeguard Assembly

presents it to the human eye. High voltage for the tube is provided by a battery power supply. The sight has an automatic brightness control feature built into the image intensifier assembly which prevents the sight from cutting off when excessive light enters the objective lens.

1.2.4 A description of the first Night Vision Sight, Individual Weapons Mounted, AN/PVS-2B, hereinafter referred to as the control item or control sight, is contained in TM 11-5855-203-13, with Change 5.

1.3 Test Objectives

1.3.1 To determine to what degree the test item meets the performance requirements of the Qualitative Materiel Requirements (QMR).

1.3.2 To evaluate the adequacy of the maintenance package.

1.4 Scope

1.4.1 The Infantry portion of the test was conducted by USAIB at Fort Benning, Georgia, under prevailing intermediate climatic conditions. Testing was initiated on 26 September 1972 and suspended on 5 January 1973. Testing was resumed on 13 May 1974 and completed on 1 November 1974.

1.4.2 The scope of this DT II (SP) was limited to testing against those QMR criteria which were not addressed in the partial report and to verification testing to determine whether the performance of the new test item was comparable to that of the original AN/PVS-4. The performance of the test item was also compared to that of the control item.

1.4.3 Ten test sights and 10 control sights were used in the Infantry portion of the service test. Adapter brackets for the M14, M16A1, M60, M67, M72A2, M79, and M203 were tested to determine compatibility with the test sight and weapons for which they were intended. Only M14 and M16A1 adapter brackets were furnished with the control sight.

1.4.4 USAIB conducted subtests involving preoperational inspection; safety; training; tactical observation; security and electrical interference; mounting brackets, sight reticle, and sight adjustment; accuracy; transportability and portability; reliability and durability; maintenance evaluation; human factors; and value analysis. The sights were operated by 10 test soldiers representative of those who would normally be required to operate and maintain them. Three test soldiers wore glasses (with vision correctable to 20/20). Two were lefthanded. The tactical observation subtest was conducted during moonlight and starlight conditions (para 1.4.9) over flat, open terrain with no brush and over flat terrain with

grass and brush. A sufficient number of observations was made at each location under the two light conditions to determine whether statistically significant differences existed between the test and control items. Accuracy firing exercises were conducted during daylight and darkness with all weapon/sight combinations. The results of the night firing were compared to the daylight firing results. The test item was compared to the control item in firing exercises employing the M16A1 and M14 only.

1.4.5 A telephotometer was used to measure light conditions. The position and phase of the moon were also recorded during the tactical observation and accuracy subtests.

1.4.6 During accuracy and tactical observation subtests, the principles of planned grouping, randomization, and replication were used to minimize bias and learning effects. Results were subjected to analyses of variance at the .10 level of significance.

1.4.7 Reliability testing was a time-terminated replacement type test. Failures were assumed to have been exponentially distributed. The Mean Time Between Failure (MTBF) and reliability characteristics of the test sight were analyzed using the statistical techniques of hypothesis testing.

1.4.8 A maintenance evaluation was conducted in accordance with TECOM Supplement 1 to AR 750-1.

1.4.9 The following definitions applied throughout the conduct of the test:

a. Detection - Indication of the presence of a target of potential military interest in a reasonable time, but without recognition of the object.

b. Recognition - Discrimination between targets (objects) as to class, e.g., APC, truck, man.

c. Identification - Discrimination between targets (objects) within a class, e.g., friendly or enemy soldiers.

d. Moonlight conditions - Illumination between the limits of 1×10^{-3} to 4×10^{-2} foot-candles.

e. Starlight conditions - Illumination between the limits of 1×10^{-4} to 4×10^{-4} foot-candles.

f. Clear air - The condition that exists during unlimited visibility, i.e., no ground fog, haze, or clouds.

g. Overcast conditions - Illumination between the limits of 1×10^{-5} to 4×10^{-5} foot-candles. Overcast conditions did not occur during the period field testing was conducted.

h. Night conditions - Illumination of 4×10^{-2} foot-candles or less.

SECTION 2. DETAILS OF TEST

2.1 PREOPERATIONAL INSPECTION AND PHYSICAL CHARACTERISTICS

2.1.1 Objective

To determine whether the test sights and accessories were complete and serviceable.

2.1.2 Criterion

The test and control sights and accessories will be complete and serviceable. (item 44, app B)

2.1.3 Method

2.1.3.1 The test and control equipment was inventoried against the packing list to insure completeness.

2.1.3.2 The test and control sights and accessories were weighed, measured, and photographed.

2.1.3.3 The test and control sights and accessories were inspected for serviceability and damage. Particular attention was given to proper functioning of the azimuth and elevation knobs, tube brightness and reticle brightness control knobs, OFF/ON switches, range focus rings, and diopter rings. Lenses were inspected for cracks, chips, and scratches and for fogging, condensation, or other signs of moisture on the internal elements. All decals and diopter scales were inspected to insure they were readable. Proper functioning was determined by placing the sights in operation as prescribed by the accompanying draft technical manual provided by the developer.

2.1.3.4 Batteries to be used during testing were checked on a voltmeter to insure they contained the prescribed voltage.

2.1.3.5 Mounting brackets with sights attached were mounted on their respective weapons to insure compatibility.

2.1.4 Results

2.1.4.1 The test and control items were complete.

2.1.4.2 Photographs of the test and control items with accessories are shown in Figures A-1 through A-18, Part I, Appendix A.

2.1.4.3 The mean weight, length, width, and height of the test and control sights and accessories are depicted in Tables 1 and 2.

Dimensions	Sights	
	Test	Control
Length	12-5/8	17-11/16
Width	4-15/32	3-3/4
Height	4-35/64	8-1/8

Table 1. Mean Dimensions of Test and Control Sights (Measurements in Inches)

Item	Test	Control
Shipping container	7 lb 12 oz	7 lb 14 oz
Case, carrying	9 oz	16.5 oz
Sights without batteries or lens covers	3 lb 11 oz	6 lb 1.5 oz
Sights with batteries and lens covers	4 lb .50 oz	6 lb 9 oz
Battery	.75 oz	7.5 oz
Lens cover	4 oz	2 oz
Eyeshield (rubber)	2.25 oz	2.5 oz

Table 2. Mean Weights of Test and Control Sights and Accessories

2.1.4.4 Mounting brackets for the following weapons were provided with the test sights:

a. Rifle, 5.56-mm, M16A1.

b. Rifle, 7.62-mm, M14.

c. Grenade launcher, 40-mm, M79.

d. Grenade launcher, 40-mm, M203.

e. Light Anti-tank Weapon, 66-mm, M72A2

f. Machine gun, 7.62-mm, M60.

g. Recoilless rifle, 90-mm, M67.

Brackets for the M16A1 and M14 rifles were packed with the test sight in the shipping container. No suitable container was provided for transporting and storing the other test sight brackets.

2.1.4.5 The mean weights and dimensions for the test sight brackets are depicted in Table 3.

Measurements	M16A1	M14	M79	M203	M72A2	M60	M67
Weight	1.5 oz	4.75 oz	1 lb 4 oz	1 lb 2 oz	14.25 oz	1 lb 2 oz	11 oz
Length	2-1/2 in	4-7/8 in	6 in	4 in	4-1/4 in	6-5/8 in	3-3/8 in
Width	1-1/4 in	1-7/8 in	4-1/2 in	3-7/8 in	5-5/8 in	4-13/16 in	5 in
Height	1 in	2-5/16 in	4-7/16 in	3-3/8 in	4-1/2 in	3-13/16 in	4-1/4 in

Table 3. Mean Weights and Measurements of Test Sight Brackets

2.1.4.6 Brackets for the M16A1 and M14 rifles were provided for the control sight. These items were included with the control sight in the shipping container.

2.1.4.7 The mean weights and dimensions for the control sight brackets are depicted in Table 4.

Measurements	M16A1	M14
Weight	6 oz	2-1/2 oz
Length	5-1/8 in	5 in
Width	3-7/8 in	1-1/4 in
Height	1-1/8 in	7/8 in

Table 4. Weights and Measurements of Control Sight Brackets

2.1.4.8 The maintenance package provided with the test sights was adequate, except that no M67 reticles were furnished with the maintenance package.

There were some reticles labelled as M67, but were in fact another type. Proper M67 reticles were provided by the NVL representative in time for use during field testing.

2.1.4.9 A low temperature adapter assembly was not provided with the test equipment. This item was not included in the scope of the test; however, it will be tested during the arctic test.

2.1.4.10 The test sights could be mounted on the weapons, using the appropriate adapter brackets, except that the adapter brackets for the M60 machine guns could not be mounted properly on the weapon. The right bracket clamp did not seat properly under the feed cover of the M60 machine guns. However, modifications were made by the technical representative of NVL that corrected this problem prior to the start of field testing.

2.1.4.11 The test sights and all controls were operational, except that the reticle would not illuminate on one test sight. This failure was attributed to a defective illuminator assembly, which was replaced by the direct support repairman. The test sight was then operational. Lenses were free of cracks, chips, and scratches. Batteries used contained the prescribed voltage.

2.1.5 Analysis

The test sights meet the criterion stated in paragraph 2.1.2.

2.2 SAFETY

2.2.1 Objective

To determine whether the test items are safe for their intended use and to verify the adequacy of the safety statement.

2.2.2 Criterion

The test item will be safe to operate and maintain. (item 43, app B)

2.2.3 Method

2.2.3.1 The safety release was evaluated to determine whether there were any features unduly restrictive or difficult to comply with and whether the safety release covered the safety requirements necessary in the operation of the test sight.

2.2.3.2 This subtest was conducted concurrently with all other subtests. All subtests were conducted in compliance with safety requirements and the safety release.

2.2.3.3 During the conduct of all testing, observations were made to determine whether any unsafe conditions or safety hazards exist.

2.2.3.4 Test soldiers were required to undergo an eye examination prior to testing to determine whether they were within the Army standards of visual acuity for combat service. A night vision adaptability test was also administered to the test soldiers to determine if they were night blind. A confirmatory eye examination was given when the test was concluded to determine if there was any eye deterioration.

2.2.4 Results

2.2.4.1 The safety release contained no features which were unduly restrictive.

2.2.4.2 The optometrist administering the confirmatory eye examination when the test was completed concluded that test soldiers had suffered no degradation in visual acuity.

2.2.4.3 The rubber eye shield separated from the test sight on four different occasions during the conduct of the test. The safety release specified that the rubber eye shield must remain in position during all weapon firing to prevent head and eye injury.

2.2.5 Analysis

The test item meets the criterion stated in paragraph 2.2.2. The safety release was verified. However, should the rubber eye shield separate from the test sight, a soldier attempting to engage targets would be subject to head or eye injuries from weapon recoil. This is classified as a durability and reliability deficiency (para 2.9.5.5b).

2.3 TRAINING

2.3.1 Objectives

2.3.1.1 To familiarize the test soldiers with the functioning, use, and maintenance of the weapons on which the test and control sights were to be mounted.

2.3.1.2 To determine the amount of training required by test soldiers to insure safe and proper use of the test and control sights.

2.3.1.3 To determine the training required to qualify personnel to operate and maintain the test item.

2.3.1.4 To determine the adequacy of the training publications provided.

2.3.2 Criteria

2.3.2.1 The test soldiers must be sufficiently trained and oriented to insure safe and proper use of the test and control items and their respective weapons. (item 41, app B)

2.3.2.2 Test soldiers must be sufficiently trained to properly maintain the test and control items and their respective weapons. (item 42, app B)

2.3.3 Method

2.3.3.1 Ten soldiers were selected as test personnel. They had an average of 3 years and 4 months military experience. One of the individuals had served as a combat Infantryman in Vietnam and had employed the control item as a hand-held observation device on tactical operations. None of the 10 soldiers had employed the control item as a weapon sight. Two of the test soldiers had M16 rifle qualification as marksmen, four as sharpshooter, and four as expert.

2.3.3.2 Test soldiers received a total of 4 hours of refresher training. This training was on the M16A1, M14, M60, M79, M203, and M72A2, and included:

a. Assembly and disassembly.

b. Functioning.

c. Zeroing procedures.

d. Marksmanship.

Training on the M67 was not conducted since qualified M67 gunners (MOS 11H20) were used as test soldiers for that portion of the test which dealt with this weapon.

2.3.3.3 Test soldiers were required to observe and fire a pre-test night familiarization/functional exercise with the M16A1 rifle. This was to insure that they were operating the weapons with test and control sights safely and properly.

2.3.3.4 Instruction pertaining to the test and control sights was based upon Training Circular 23-11, Night Vision Sights; Army Subject Schedule 23-39; TM 11-5855-203-13, with Changes 1 through 5; and DTM 11-5855-213-12, which was provided with the test sights. Training consisted of 3 hours of conference/demonstration type instruction and 4 hours of practical work on the range for each test and control sight.

a. The first hour was a conference/demonstration on the characteristics, tabulated data, components and accessories, operation, and functioning of the sight.

b. The second hour was a conference/demonstration and practical exercise on disassembly, assembly, installation, and maintenance of the sight.

c. The third hour was a conference/demonstration on aiming positions, zeroing procedures, and factors affecting employment of the sight.

d. The 4 hours of practical work on the range was conducted under the prevailing temperate climatic conditions. During the training exercise, test soldiers were required to attach the sight to all weapons, and to adjust and zero it to the M16A1 rifle in accordance with the procedures described in the appropriate literature. They also fired a target engagement exercise with the M16A1 rifle/sight combination during darkness in accordance with Table 1, paragraph 35, TC 23-11. During this night firing, soldiers engaged E-type silhouettes located at distances of 75, 150, 250, and 300 meters with test and control combinations. The number of hits achieved at each range by each test soldier was recorded.

2.3.3.5 A training evaluation was conducted at the conclusion of the subtest. Each test soldier was required to perform the following tasks in the presence of the test officer:

a. Install respective brackets on the following weapons correctly: M16A1, M14, M60, M67, M72A2, M79, and M203.

b. Install and remove battery and describe operator maintenance procedures.

c. Identify controls and describe their function.

d. Place sight into operation.

e. Describe zeroing procedures.

f. Demonstrate the procedures that must be followed to insure safe and proper handling of the sight.

2.3.3.6 Observations were made throughout testing on difficulties encountered by test soldiers in the operation and use of the test and control items.

2.3.4 Results

2.3.4.1 The test soldiers demonstrated a good working knowledge of all weapons to be employed during the conduct of the test. They were familiar with their assembly, disassembly, functioning, and the correct zeroing procedures using standard iron sights.

2.3.4.2 The test soldiers had no difficulty employing the test sight as a hand-held observation device. All test soldiers were proficient in those tasks performed during the training evaluation.

2.3.4.3 Zeroing procedures that were used are reported in paragraph 2.6, Mounting Brackets, Sight Reticle, and Sight Adjustment.

2.3.5 Analysis

2.3.5.1 The training outlined in Army Subject Schedule 23-39 is adequate to train personnel sufficiently to insure safe and proper handling of the test sight. Maximum use of all available time was required. It is also adequate to train personnel to operate and maintain the sight. The soldier's ability to employ the test item either as a weapon sight or as a hand-held observation device improves as he becomes more familiar with the sights and the techniques of their employment.

2.3.5.2 After the prescribed training, the test soldiers are sufficiently trained to insure safe and proper use and maintenance of the test and control sights and their respective weapons. The criteria in paragraphs 2.3.2.1 and 2.3.2.2 are met.

2.4 TACTICAL OBSERVATION

2.4.1 Objective

To determine the capabilities and/or limitations of the test soldier, using the test and control sights, to recognize targets of potential military interest over various types of terrain, at different ambient light levels and ranges.

2.4.2 Criterion

Range. (Essential) Recognize a standing man from 25 to at least 400 meters in clear air and starlight and 25 to at least 600 meters in clear air and moonlight. (item 1, app B)

2.4.3 Method

2.4.3.1 Ten test soldiers employed the test and control items in the hand-held role from a simulated defensive position. They attempted to detect, recognize, and identify man targets at specified ranges. The range to

each target was unknown to observers. Information on targets and ranges is given in Figure 2. This exercise was repeated until all test soldiers had made two observations of each of the seven arrays with the test item and with the control item. This was a timed exercise. Observers were required to report to a recorder the targets they detected, recognized, and identified. Targets not detected within 3 minutes were moved laterally for 1 minute in order to help disclose their positions. Some of the targets wore black clothing and a different type of headgear for the purpose of determining whether or not observers were able to identify targets. The number and types of targets presented at each range are shown in Figure 2. These exercises were conducted on the same terrain used in the Service Test of the AN/PVS-4 (February 1973) (Test Areas I and II) (ref 8, app F, and Figures A-19 and A-20, Part I, Appendix A). This exercise was conducted once under clear air and moonlight and again under clear air and starlight.

2.4.3.2 Upon conclusion of testing described in paragraph 2.4.3.1, the data obtained was compared with similar data collected in paragraph 2.4.4.1, Service Test (February 1973) (ref 8, app F).

2.4.3.3 Failure rates precluded all test items being physically present. Throughout the conduct of the observation subtest, at least 9 control items and 9 test items were present during the conduct of each exercise.

2.4.4 Results

2.4.4.1 The exercise described in paragraph 2.4.3.1 was conducted during the period 17 June to 3 August 1974. A comparison of the percentage of single targets detected and recognized by 10 observers using the test and control sights, under each light condition/terrain type combination, is depicted in Tables A-1 through A-4, Part III, Appendix A.

2.4.4.2 The probability of detection (P(D)) of single man targets detected/total under each light condition/terrain type combination is depicted in Tables A-1 and A-2, Part III, Appendix A.

2.4.4.3 The probability of recognition (P(R)) of single man targets recognized/total under each light condition/terrain type combination is depicted in Tables A-3 and A-4, Part III, Appendix A.

2.4.4.4 The P(D), P(R), and probability of identification (P(I)) for single and multiple targets under each light condition/both terrain type combinations are shown in Tables A-5 through A-7, Part III, Appendix A.

2.4.4.5 The illumination, position, and phase of the moon are depicted in Figures A-25 through A-28, Part I, Appendix A, and Table A-8, Part III, Appendix A.

1. NUMBER AND TYPES OF TARGETS (4 each)

   a. Single Individual (SI)

   b. Multiple (2) Individual (MI)

   c. Single Individual, Enemy (SI)(EN)

   d. Multiple (2) Individual, Enemy (MI)(EN)

2. RANGES TO TARGETS: 25, 50, 100, 200, 300, 400 and 600 meters.

3. ARRAYS

	Target	Range
a. Array 1	SI	50
	SI (EN)	100
	MI	400
	MI (EN)	200
b. Array 2	MI	50
	SI (EN)	400
	SI	200
	MI (EN)	600
c. Array 3	SI (EN)	50
	SI	100
	MI	600
	MI (EN)	300
d. Array 4	MI (EN)	100
	SI (EN)	25
	MI	200
	SI	600
e. Array 5	SI	400
	MI	100
	SI (EN)	300
	MI (EN)	25
f. Array 6	SI (EN)	200
	SI	25
	MI (EN)	50
	MI	300

Figure 2. Information on Arrays

g. Array 7

SI	300
MI (EN)	400
MI	25
SI (EN)	600

4. NUMBER OF TARGET OBSERVATIONS

Target	25	50	100	200	300	400	600
Single Individuals	20	20	20	20	20	20	20
Single Individuals (Enemy)	20	20	20	20	20	20	20
Multiple Individuals	20	20	20	20	20	20	20
Multiple Individuals (Enemy)	20	20	20	20	20	20	20

Figure 2 (continued)

2.4.4.6 The following information was extracted from the data collected in the exercise described in paragraph 2.4.3.1:

a. Under Moonlight Conditions, Test Area I, Single Standing Man Targets, Test Sight:

(1) The P(R) from 25-600 meters is .866.

(2) The P(R) at 600 meters is .700.

b. Under Starlight Conditions, Test Area I, Standing Man Targets, Test Sight:

(1) The P(R) from 25-400 meters is .803.

(2) The P(R) at 400 meters is .519.

c. Under Moonlight Conditions, Test Area II, Single Standing Man Targets, Test Sight:

(1) The P(R) from 25-600 meters is .627.

(2) The P(R) at 600 meters is .100.

d. Under Starlight Conditions, Test Area II, Single Standing Man Targets, Test Sight:

(1) The P(R) from 25-400 meters is .657.

(2) The P(R) at 400 meters is .296.

2.4.5 Analysis

2.4.5.1 The test item meets the criterion stating that it will enable the operator to recognize a standing man from 25 to at least 400 meters in clear air and starlight and 25 to at least 600 meters in clear air and moonlight.

2.4.5.2 The data in Tables A-1 through A-4, Part III, Appendix A, was analyzed using the Hald proportion test at the .10 level of significance. The results of this analysis indicate that:

a. The P(R) for the test sight (.866) was better than the control sight (.797) under moonlight conditions.

b. The P(R) for the test sight (.803) was better than the control sight (.736) under starlight conditions.

c. The significant differences in light band and range were expected since they were included as control variables.

d. In summary, the analysis indicated that the test sight performed equally good or better than the control sight against single targets at all ranges under both light conditions on both test areas.

2.4.5.3 The performance capability of the test and control sights to observe targets of potential military interest at different ambient light levels and ranges is comparable. Overall, neither sight offers a significant advantage over the other. The detection, recognition, and identification capabilities of both sights are dependent upon the individual operator and sight, sight locations, and ambient light conditions. Targets located in close proximity to tree lines and other forms of noncontrasting vegetation that break silhouette continuity are difficult to detect whether the operator is using the test or control sight.

2.4.5.4 The P(R) performance of the test item was compared to the P(R) of the test sight in the Service Test (February 1973). The comparison was limited to single personnel targets during moonlight and starlight under approximately the same collection conditions.

a. There is no significant difference between the P(R) during moonlight in the Service Test (.862) and this test (.866).

b. There is no significant difference between the P(R) during starlight in the Service Test (.789) and this test (.803).

c. The performances of the test sight in the Service Test and the DT II are equal.

2.5 SECURITY AND ELECTRONIC INTERFERENCE

2.5.1 Objective

To determine whether the test sight meets the criteria pertaining to security and electronic interference.

2.5.2 Criteria

2.5.2.1 The operation of the weapon sight will not interfere with communications, surveillance, or other COMMEL equipment or vice versa. (Essential) (item 37, app B)

2.5.2.2 Cover and deception. Item will be completely passive and no more detectable at night (with reasonable precautions as far as the eyepiece

is concerned) than is the operator and his weapon without the sight. (item 40, app B)

2.5.3 Method

2.5.3.1 Test supervisory personnel attempted to detect a test and control sight with a metascope at night. The exercise was conducted with the test and control sights turned on and off. The terrain was a flat asphalt landing strip.

2.5.3.2 Test supervisory personnel began at a range of 25 meters directly in front of the test and control sights. They used the metascope (SU-43/U) with the infrared light source (MX-7987/PAS-6) to locate the test sights. Test supervisory personnel continued to increase the distance between the test and control sights and the metascope until no reflection was observed.

2.5.3.3 The metascope was used as a viewing device without the aid of the infrared emitter and with the aid of the infrared emitter.

2.5.3.4 During previous testing (ref 8, app F), the test items were evaluated for compatibility with communications and surveillance equipment.

2.5.4 Results

2.5.4.1 The test and control sights were detected with the metascope at distances of 600 and 400 meters, respectively. The detection was caused by the infrared light source being reflected from the objective lens back to the metascope receiver and was not caused by any light radiation from the test or control sights. This reflection was clear and distinct to personnel making a frontal approach and looking directly into the lens of the test sight; the reflectivity decreased drastically when the observer moved to the right or left. This reflectivity is common to all mirror-like surfaces.

2.5.4.2 The metascope could detect the test and control sights only while the infrared emitter was turned on.

2.5.4.3 During the previous testing (para 2.5.3.4), the operation of the test sight did not interfere with any communications or surveillance equipment. Neither did that equipment interfere with the operation of the test sight.

2.5.5 Analysis

The criteria stated in paragraph 2.5.2 is met; however, when viewed directly into the lens, the test sight can be detected by an observer using

an active infrared light source and viewing device. This is considered insignificant.

2.6 MOUNTING BRACKETS, SIGHT RETICLE, AND SIGHT ADJUSTMENT

2.6.1 Objective

To determine the suitability of the mounting brackets and sight reticle, and to determine whether sight adjustment is necessary when the test sight is mounted and dismounted.

2.6.2 Criteria

2.6.2.1 (Essential) A mounting bracket will be developed for each of the weapons listed ***, taking into account the method of employment and the muzzle velocity. Mounting brackets will permit quick, simple attachment of the sight in darkness. The brackets must allow repeated mounting and dismounting of sights without significant change in zero. *** Mounting brackets will be furnished for the following weapons:

a. M14 rifle.

b. M60 machine gun.

c. M72 rocket launcher.

d. M79 grenade launcher.

e. M16A1 rifle.

f. M67 recoilless rifle.

g. M203 grenade launcher (attached to the M16A1).

(item 11, app B)

2.6.2.2 (Essential) The reticle will be designed so that the sight picture for each weapon *** is as close as possible to the sight picture obtained with the applicable daylight sight. The reticle shall not obscure the target by side flow effects. *** (Desirable) A minimum number of reticle patterns is desired consistent with ballistic characteristics of the various weapons involved. *** (item 20, app B)

2.6.2.3 (Essential) Design will make provision for indications of clicks both audibly and in a manner sensitive to touch to facilitate zeroing.

Zeroing procedure will be essentially the same as for daylight sights. (item 21, app B)

2.6.3 Method

2.6.3.1 Compatibility between sights, brackets, and weapons was initially determined in paragraph 2.1, Preoperational Inspection and Physical Characteristics. Throughout the conduct of all testing, the suitability of the test sight reticles was evaluated and compared with the sight picture obtained with the standard daylight sight.

2.6.3.2 During this subtest, observations were made by test supervisory personnel to determine whether the reticles were consistent with the ballistic characteristics of the weapons they were used with, and whether the number of different reticles could be decreased or combined.

2.6.3.3 Ten test sights with brackets were mounted on the M14 and M16A1, M60, and M203. Four test sights with brackets were mounted on the M79, M72A2, and M67. They were then zeroed, aligned, or boresighted, as appropriate, in accordance with the procedures outlined in the draft technical manual (DTM) and information furnished by Night Vision Laboratory. In some instances, where no procedures were furnished, the Infantry Board used procedures that appeared practicable to accomplish the necessary zeroing. The sights were then dismounted from the weapons. Subsequently, they were remounted and the zero confirmed. This exercise was performed 10 times during darkness and 10 times during daylight (with the daylight cover on) to determine whether there was any significant difference between zeroes after repeated mounting and dismounting of the test sights. The mean offset was computed for the shot groups achieved with the M14, M16A1, and M60 weapons; the initial shot groups were compared with each resultant shot group. The hit probability was computed for all other weapons.

2.6.3.4 The sight is designed to be zeroed during either daylight or darkness. If done in daylight, the daylight cover must be used.

2.6.3.5 Procedures used to zero the M14, M16A1, and M60 (from the DTM):

a. Place or select a target having an aiming point at a range of 25 meters. Assume a comfortable position and support the weapon and sight combination with sandbags, stakes, or any other available equipment that will afford maximum stability.

b. Place the sight into operation.

NOTE: Adjust the azimuth and elevation knobs so that the aiming point is approximately in the center of the field of view of the sight. Fire a

few rounds to seat the sight to the weapon. Retorque all mountings holding the sight to the weapon.

c. Place the zeroing range aiming point of the reticle on the target aiming point and fire three rounds to attain a good shot group. Check the target to determine the location of the center of the shot group.

d. Using the same aiming point, adjust the reticle by adjusting the elevation and adjustment knob to move the center of the shot group a distance of 3.5 centimeters directly below the upper "X" for the M14, 4.6 centimeters directly below the lower "X" for the M16A1, and 11.9 centimeters for the M60, respectively.

2.6.3.6 Procedure used to zero the M67 in daylight (from the DTM):

a. Select a stable position for the weapon to which the sight is to be zeroed.

b. Select a target and zero the weapon on that aiming point using the daylight sights.

c. Remove daylight sight and attach AN/PVS-4.

d. Place the sight into operation.

e. Adjust the azimuth and elevation knobs on the sight until the correct aiming point on the reticle pattern is zeroed on the target.

f. Normal zeroing range is 400 meters.

2.6.3.7 No procedures were provided in the DTM for zeroing the M67 at night. The following USAIB procedures were used to zero the M67 at night:

a. During darkness, an E-type silhouette was placed at a distance of 40 feet. A 1/2-inch hole was made in the silhouette, and a flashlight with a red filter was mounted behind the target. The M67 was boresighted to this light.

b. The night sight was mounted to the M67, and the zero cross on the reticle was brought into coincidence with the light and the boresight of the weapon.

2.6.3.8 Procedures used to zero the M72 in daylight (from the DTM) were the same as for the M67 recoilless rifle, except that the daylight sight was not removed after use in zeroing, and the normal zeroing range is 200 meters.

2.6.3.9 No procedures were provided in the DTM for alignment of the M72 at night. The following USAIB procedures were used at night:

a. An E-type silhouette was placed 25 meters from the weapon. A 1/2-inch hole was placed in the center of the silhouette. A flashlight with a red filter was attached to the rear of the silhouette.

b. The weapon's integral sight was aimed at the red light using the 100-meter promethium cross. Without moving the weapon, the reticle of the night sight was moved so that the 100-meter range line was centered on the red light.

2.6.3.10 Zero procedures for the M203 (from the DTM) were the same as for the M16A1 rifle. Range selection is obtained by using bracket elevation adjustment.

2.6.3.11 Procedures used to zero the M79 in daylight (from the DTM):

a. Select a stable position for the weapon to be fired from.

b. Adjust the azimuth and elevation knobs to place the zero aiming point approximately in the center of the field of view of the sight.

c. Select a suitable target, use the proper reticle aiming point and elevation setting for range, and fire one round.

d. Retighten lower locking knob and adjust azimuth and elevation settings, if necessary, to correct misalignment shown from firing the first round. Repeat the reticle adjustment-firing sequence until the sight is boresighted to the weapon.

e. Normal zeroing range is 200 meters.

2.6.3.12 Mounting brackets and test sights were observed for interference with weapon functioning.

2.6.3.13 The methods of mounting the test sight to the brackets were examined for relative ease, quickness, and simplicity and were compared to the methods used for the control sights and brackets.

2.6.3.14 During the zeroing exercises and all firing exercises, observations were made to determine the effects of reticle side flow, if any.

2.6.3.15 Throughout the conduct of this test, the audibility and sensitivity of clicks in the control knobs and switches were noted. Ten test soldiers manipulated the test sights during darkness and determined

whether the clicks were audible and sensitive to touch. They repeated this exercise while wearing temperate weather gloves.

2.6.4 Results

2.6.4.1 The incompatibility of the M60 brackets noted during the pre-operational inspection (para 2.1.4.10a) had been corrected prior to the start of field testing.

2.6.4.2 The following incidents were noted during testing:

a. One M72A2 bracket assembly shoulder screw sheared off, causing loss of the locking latch which secured the bracket in place on the LAW.

b. The foot on two test sights would not seat properly into the M60 mounting bracket assemblies. The close tolerance would not permit the night vision sight mounting adapter to seat properly.

c. The socket head screw on one M14 rifle mounting bracket assembly was found missing. The loss of the screw prohibits the use of the sight as a weapon sight on the M14 rifle.

d. The mounting bracket knobs on all brackets can be inadvertently lost due to the knobs having no retention devi s.

e. There is no suitable method of transporting the mounting brackets when they are not attached to their respective weapons.

f. Attachment of the M60 and M79 brackets requires partial disassembly of the weapons.

2.6.4.3 Mounting brackets did not interfere with weapon functioning when mounted on the weapon with or without the test sight attached.

2.6.4.4 Results of the exercise conducted to determine whether or not the brackets could be attached with quickness and simplicity were as follows:

a. Test soldiers experienced the most difficulty attempting to attach the bracket to the M60 machine gun. Attachment required the test soldier to remove the feed tray cover pin and replace it with a longer pin that secured the front of the M60 bracket to the machine gun.

b. A comparison of the time required to attach and detach the test and control brackets and test and control sights to their respective weapons at night is shown in Table 5. Tables A-9 through A-15, Part III, Appendix A, show detailed results of these computations.

	MEAN TIME TO MOUNT TEST	MEAN TIME TO DISMOUNT TEST	MEAN TIME TO MOUNT CONTROL	MEAN TIME TO DISMOUNT CONTROL
M14	1 min 33 sec	47 sec	43 sec	36 sec
M16	46 sec	10 sec	59 sec	20 sec
M60	4 min 14 sec	2 min 26 sec	NA	NA
M79	1 min 51 sec	1 min 44 sec	NA	NA
M203	1 min 12 sec	34 sec	NA	NA
M72	1 min 20 sec	40 sec	NA	NA
M67	24 sec	22 sec	NA	NA

Table 5. Mounting and Dismounting of Test and Control Sights and Brackets (Night)

2.6.4.5 The use of 5.56-mm and 7.62-mm cartridge cases, dog tags, coins, or other suitable tool was adequate for making necessary azimuth and elevation sight changes to the test item.

2.6.4.6 Test soldiers experienced some difficulty in zeroing their weapon-sight combinations during all firing subtests for the following reasons:

a. Adjustment of the azimuth and elevation adjustment mechanisms did not always result in a corresponding change in the position of the sight reticle on two test items.

b. In some cases, during high ambient light conditions, the daylight cover permitted an excessive amount of light to enter the objective lens. The light obscured the illuminated reticle. The sight was more difficult to zero during daylight than during darkness for this reason. As a field expedient, the test soldiers placed paper on the inside of the daylight cover to reduce the amount of light entering the objective lens. This enabled the firer to see the reticle to some extent.

2.6.4.7 The results of the zeroing exercises were as follows:

a. The zeroing procedures in the DTM for the M16A1 and M14 rifles and M60 machine gun were adequate.

b. The zeroing procedures in the DTM for the M67 and M72A2 were adequate during daylight, and the USAIB procedures were adequate for these weapons at night. Confirmatory rounds were fired and hits confirmed at 400 meters with the M67 and at 200 meters with the M72A2.

c. The M79 zeroing procedures stated in the DTM were adequate during daylight. There is no feasible method of zeroing the M79 at night due to the type of weapon and ammunition.

d. The M203 could not be zeroed accurately using the instructions in the DTM, which prescribed using the same procedures as for the M16A1. (The majority of the rounds fired to confirm zero fell 50 to 75 meters short of the target.) Therefore, the M79 procedure was used to zero the test sight on the M203, but was found to be inaccurate also, since the confirming rounds fell short of the target by approximately 25 meters. Also, the M16A1 portion of the weapon system could not be used with the sight; the M16A1 rounds impacted on the 25-meter zeroing target 40 inches above and 12 inches to the left of the M16A1 zero point. The aiming points for the rifle and the grenade launcher have a fixed relationship, and both cannot be zeroed concurrently. Zeroing one weapon system (either the rifle or grenade launcher) with the test sight would prohibit accurate use of the other weapon with the sight.

2.6.4.8 Test data to determine whether or not the brackets would allow repeated mountings and dismountings of the sights without significant change in zero was based on the timed exercises with the weapons and the test sight. The mean time to zero and the mean number of rounds to zero were computed for both day and night exercises. For comparison, the same measures were determined for the M14 and M16A1 with the control sight and the appropriate mounting brackets. Table 6 summarizes this data for night exercises. The mean offset (0) was computed for the initial shot

	Mean Time to Zero Test	Mean No Rds to Zero Test	Zero Retained Through Test	Mean Time to Zero Control	Mean No Rds to Zero Control	Zero Retained Through Control
M14	21min18sec	18	5 Dismountings	27min36sec	22	10 Dismountings
M16	28min18sec	16	10Dismountings	18min30sec	15	10 Dismountings
M60	20min30sec	11	0 Dismounting	NA	NA	NA
M79	21min30sec	7	NA	NA	NA	NA
M203	41min12sec	29	NA	NA	NA	NA
M72	6min42sec	NA	NA	NA	NA	NA
M67	NA	NA	NA	NA	NA	NA

Table 6. Night Test Zeroing Results with the AN/PVS-4

groups achieved with the M14 and M16A1 with the test and control sights, and the M60 with the test sight only, during both day and night firing. The mean offset was computed based on zero confirmation and after one, five, and ten dismountings and mountings of the sight. The hit probability was computed for the M79, M203, M72A2, and M67. Tables A-16 through A-19, Part III, Appendix A, show the detailed results of these computations.

2.6.4.9 During zeroing of the M203, a large number of 40-mm rounds were used to confirm zero. The large number of rounds required to confirm zero with the M203 are attributed to the inadequate zeroing procedures prescribed in the DTM, as discussed in paragraph 2.6.4.7d above.

2.6.4.10 Three different types of reticles were provided for the test. There was a type reticle to accommodate each of the following groups of weapons:

a. M14 and M16A1 rifles, M79 and M203 grenade launchers, and the M60 machine gun.

b. M67 recoilless rifle.

c. M72A2 LAW.

2.6.4.11 Test soldiers experienced difficulty in zeroing their weapon-sight combinations during all firing subtests for the following reasons:

a. The sight reticle was difficult to distinguish in high ambient light levels (bright daylight, heavy overcast daylight, bright moonlight, dawn, and dusk).

b. The reticle pattern tended to wash out when viewed against a light-colored object.

c. The M16A1-M14-M60 range increment marks on the test sight were not the same as on the standard iron sight.

d. The reticle pattern for the M16A1, M14, and M60 was confusing to the gunners. The first range mark was at 400 meters. Gunners had to interpolate ranges varying from 50 to 400 meters with this reticle. This interpolation at different ranges was difficult to do.

2.6.4.12 Test soldiers and supervisory personnel made repeated reticle adjustments throughout testing. The reticle adjustment mechanisms were audible and sensitive to the touch.

2.6.4.13 There were no reported incidents of the test sight reticle obscuring the target because of side flow effects (haziness in the edges of the reticle).

2.6.5 Analysis

2.6.5.1 The criterion stated in paragraph 2.6.2.1 is met except for the following:

a. All brackets except the M60 brackets permit repeated mounting and dismounting without significant change in zero. The M60 bracket is difficult to mount on the M60 machine gun and causes the test sight to lose its zero after one dismounting. The lack of zero retention for the test sight mounted on the M60 machine gun is attributed to the mounting bracket assembly and its interface with the M60 machine gun feed tray cover. The feed tray cover on the M60 machine gun is not designed to support the sight bracket. Constant opening and closing of the cover, necessary to load and fire the weapon, causes frequent small changes in sight alignment; and a degree of movement in the feed tray cover when the weapon is fired also causes small changes. The incompatibility of the M60 bracket with the M60 machine gun is a shortcoming.

b. The M203 adapter bracket range scale is not graduated correctly. This is a shortcoming.

2.6.5.2 The criterion stated in paragraph 2.6.2.2 is not met.

a. There are three different reticle patterns. This is the minimum number required to accommodate the various weapons for which the sight is intended.

b. The reticle sight picture is different from the daylight sights of the M16A1, M14, M60, M79, and M203. This is a shortcoming.

c. The ranging dots in the reticle pattern for the M16A1, M14, and M60 require the firer to interpolate range settings between 50 and 400 meters. This is a shortcoming.

d. The illuminated sight reticle is hard to distinguish during high ambient light levels (bright daylight, heavy overcast daylight, bright moonlight, dawn, and dusk); consequently, the weapon-sight combination cannot be zeroed nor used to deliver aimed fire on point targets during those light conditions. Inability to see the test sight reticle under all ambient light levels is an operational limitation. The soldier should be able to zero and fire the weapon-sight combination during all light conditions, and particularly at dusk, the time at which the sight will normally be attached to the weapon during tactical operations. The obscurity of the sight reticle during high ambient light conditions is a shortcoming.

e. The reticle pattern for the M14/M16A1/M60/M16-M203 and M79 clutters the viewing screen and provides the average soldier with information he does not need or seldom uses. Suggestions for improvement of the reticle are shown in Section 5, Appendix C.

f. There was no report of side flow effects in the sight reticle.

2.6.5.3 The criterion stated in paragraph 2.6.2.3 is not met:

a. The design of the reticle adjusting mechanism makes provisions for indications of clicks both audibly and in a manner sensitive to touch to facilitate zeroing.

b. The zeroing procedures are essentially the same as for daylight sights. However, the M16/M203 day sight provides only independent zeroing of the rifle or the grenade launcher (para 2.6.4.7d). The night sight can be zeroed to either the rifle or the launcher, but not to both simultaneously. This is a deficiency.

2.7 ACCURACY

2.7.1 Objective

To determine the relative firing accuracy and compatibility of the test and control combinations in darkness as compared to the daytime accuracy of the weapons.

2.7.2 Criteria

2.7.2.1 This equipment will give the combat infantryman a night firing capability which is as close to daylight capability as possible. (item 19, app B)

2.7.2.2 The weight and balance of the sight will *** not adversely affect the balance or other firing characteristics of the weapon. (item 32, app B)

2.7.3 Method

2.7.3.1 Nine of the same test soldiers who served as observers during Subtest No 4, Tactical Observation, were used as test soldiers for this subtest. The soldiers participated in accuracy firing exercises with the test and control sight mounted on the M14 and M16A1 rifles and the test sight on the M60 (with bipod), M67, M203, M79, and M72A2 weapons. Prior to each firing exercise all weapon/sight combinations were zeroed.

2.7.3.2 Firing exercises were conducted on an instrumented range facility. Riflemen equipped with the M16A1 test and control sight combinations were located in a deliberate defensive position. They engaged a scenario of stationary targets and two moving targets representing an enemy attack against their positions. Target arrays consisting of three to five E-type silhouettes were located at distances of 50, 110, 130, 190, 220, and 290 meters. Moving targets were located at distances of 190 and 280 meters. The distance to each target was unknown to the riflemen. A telephotometer was used at night to record prevailing ambient light levels. The position of the moon with respect to the location of the riflemen and targets was also recorded. The above firing exercises were repeated with the M14 test and control sight combinations and with the M60 test sight combination.

2.7.3.3 The defensive firing position was located on the military crest of the most prominent terrain. The area forward of the defensive position was flat to hilly and was bisected by a ravine. Parts of the area were cluttered with brush and trees; however, most of the targets were located in large open areas. The entire site was surrounded by pine trees. (See test area III, Figure A-21, Part I, Appendix A.)

2.7.3.4 Targets were presented in the following manner:

a. A defense scenario was presented to each firer during daylight, moonlight, and starlight Targets were exposed from 15 seconds to 4 seconds from 290 meters to 50 meters, respectively, from far to near range.

b. Nine firers were required to acquire and engage the targets as presented at each range. Rifle firing was accomplished in the semiautomatic mode with the M14 and M16A1 rifles. Firers were allowed to engage one or as many targets in each array as time permitted.

c. At the beginning of each defense scenario, a small arms gun fire simulator was used to alert the riflemen that the scenario was to begin.

d. Each of two moving targets was presented twice during the course of each scenario.

e. The defense scenario was presented until each firer had expended 165 rounds using the M14 and M16A1 rifles with the test and control sight. Firing was done under daylight with the iron sights and under moonlight and starlight with the night sights.

2.7.3.5 Four test soldiers who served as firers during accuracy firing with the M14 and M16A1 participated in accuracy firing exercises with the

test sight mounted on the M60 machine gun. The same instrumented range scenarios and procedures as outlined in paragraph 2.7.3.4 a through d above were repeated.

2.7.3.6 Four test soldiers (MOS 11H10) participated in accuracy firing exercise with the test sight mounted on the M67 recoilless rifle. They engaged a realistic mix of moving targets (moving target vehicle with a 15 X 7-1/2 foot target) and stationary targets (tank hulls and 7-1/2 X 7-1/2 foot panels) at ranges varying from 100 to 500 meters. Each weapon was fired during daylight using the standard integral sights and during darkness with the test sight. Both high explosive (HE) and practice (M67) ammunition was used.

2.7.3.7 A special exercise was conducted by the same test soldiers using the test sight mounted on the M67 recoilless rifle to engage pop-up targets (7-1/2 X 7-1/2 foot panel). The distances to the targets were unknown to the firers. The targets were exposed randomly at ranges from 100 to 500 meters. Only practice (M67) ammunition was used.

2.7.3.8 Four test soldiers participated in an accuracy firing exercise with the test sight mounted on the M72A2 LAW. They engaged stationary targets (tank hulls) at ranges of 100 and 200 meters. The weapon was fired during daylight using the standard integral sight and during darkness with the test sight. Both HE and inert M72A2 ammunition was used.

2.7.3.9 A special exercise was conducted with the M72A2 LAW and the test sight as outlined in paragraph 2.7.3.7, except the ranges were 100 to 200 meters. Only inert M72A2 ammunition was used.

2.7.3.10 Four test soldiers participated in an accuracy firing exercise with the test sight mounted on the M79 grenade launcher. They engaged stationary targets at ranges from 100 to 300 meters. Each weapon was fired during daylight using the standard integral sight and during darkness with the test sight. The same four test soldiers repeated the above exercise with the test sight mounted on the M203 grenade launcher. Only HE 40-mm ammunition was used.

2.7.3.11 A special exercise was conducted with the M79 and M203 with the test sight as outlined in paragraph 2.7.3.7, except the ranges were 100 to 300 meters. Only HE 40-mm ammunition was used.

2.7.3.12 A special exercise was conducted on the instrumented range with two test soldiers using the test sight mounted on the M16A1 rifle. Firing was done from the standing and kneeling positions. The exercise was conducted as outlined in paragraphs 2.7.3.4a through e. This additional firing was to determine the effects of the test and control sights on the weight and balance of the weapons.

2.7.4 Results

2.7.4.1 M16A1 Rifle.

a. The results of firing on the defensive scenario are shown in Table 7.

	STATIONARY TARGETS				
Light	Daylight	Starlight		Moonlight	
Sight / Range (meters)	Standard	Test	Control	Test	Control
50	84/211 = .398	70/229 = .306	0/23 = 0	67/171 = .392	22/90 = .244
110	100/277 = .361	41/215 = .191	0/80 = 0	26/103 = .252	3/17 = .176
130	120/379 = .317	10/178 = .056	0/35 = 0	58/166 = .349	66/268 = .246
190	106/297 = .357	24/387 = .062	16/216 = .074	10/196 = .051	31/229 = .135
220	15/141 = .106	4/125 = .032	0/84 = 0	11/68 = .162	0/10 = 0
300	36/328 = .109	1/169 = .006	0/63 = 0	9/165 = .054	11/220 = .050
OVERALL	461/1633= .282	150/1303= .115	16/501 = .032	181/869 = .208	133/834 = .159
	MOVING TARGETS				
190	0/150 = 0	0/501 = 0	1/322 = .003	0/257 = 0	0/192 = 0
240	0/438 = 0	0/721 = 0	0/328 = 0	0/308 = 0	0/190 = 0
OVERALL	0/588 = 0	0/1222= 0	1/650 = .001	0/565 = 0	0/382 = 0

Note: Each cell shows hits/rounds ratio and hit probability (HP)

Table 7. M16A1 Rifle Firing Results, Defense Scenario

b. The results of firing on the weight and balance exercise are shown in Table 8.

c. The results of time measurements for time to first round (TFR) and time to first hit (TFH) are shown in Table 9 for each scenario.

	STATIONARY TARGETS					
Light	Daylight		Moonlight			
Sight / Range (meters) / Position	Standard		Test		Control	
	Standing	Kneeling	Standing	Kneeling	Standing	Kneeling
50	16/74 = .216	6/36 = .167	9/20 = .450	10/35 = .286	12/56 = .214	1/12 = .083
110	8/73 = .110	3/37 = .081	5/27 = .185	5/42 = .119	3/44 = .068	1/14 = .071
130	12/76 = .158	2/33 = .060	9/35 = .257	3/48 = .063	3/67 = .044	0/22 = 0
190	10/66 = .152	1/39 = .026	3/37 = .081	5/49 = .102	4/64 = .063	1/20 = .050
220	1/26 = .038	0/12 = 0	3/21 = .143	2/36 = .056	0/39 = 0	0/15 = 0
300	2/70 = .029	3/35 = .086	0/36 = 0	0/46 = 0	2/69 = .029	0/17 = 0
OVERALL	49/385 = .127	15/192 = .078	29/176 = .165	25/256 = .098	24/339 = .071	3/100 = .030
	MOVING TARGETS					
240	0/86 = 0	0/66 = 0	0/68 = 0	0/54 = 0	0/91 = 0	0/24 = 0
190	0/25 = 0	1/50 = .020	0/29 = 0	0/29 = 0	0/66 = 0	0/18 = 0
OVERALL	0/111 = 0	1/116 = .009	0/97 = 0	0/83 = 0	0/157 = 0	0/42 = 0

NOTE: Each cell shows hits/round ratio and hit probability.

Table 8. M16A1 Rifle Firing Results, Weight and Balance Scenario

Scenario	Mode	Light	Daylight		Moonlight				Starlight			
		Sight	Standard		Test		Control		Test		Control	
		Measure	TFR	TFH	TFR	TFH	TFR	TFH	TFR	TFH	TFR	TFH
Defense	Stationary	$\bar{x}$	4.400	5.501	4.913	5.581	4.814	6.418	6.319	6.297	5.819	6.951
		s	1.581	2.289	2.869	2.600	2.00	2.428	3.378	2.621	4.676	3.317
		n	399	219	222	85	215	60	410	75	167	11
	Moving	$\bar{x}$	5.590		5.799		6.221		5.831		5.373	9.840
		s	1.933	NA	4.269	NA	2.737	NA	3.778	NA	4.736	--
		n	104		107		105		230		114	1
Balance (Kneeling)	Stationary	$\bar{x}$	3.466	4.370	3.364	5.239	4.018	4.815				
		s	2.238	2.367	1.096	2.244	4.136	.290	NA	NA	NA	NA
		n	36	12	63	18	23	2				
	Moving	$\bar{x}$	3.268		3.649		4.069					
		s	2.141	NA	2.044	NA	2.326	NA	NA	NA	NA	NA
		n	12		19		8					
Balance (Standing)	Stationary	$\bar{x}$	3.966	4.312	3.560	6.257	3.870	5.582				
		s	2.121	1.871	1.447	2.876	2.073	2.590	NA	NA	NA	NA
		n	103	34	46	21	74	18				
	Moving	$\bar{x}$	3.980		3.757		3.995					
		s	1.751	NA	2.068	NA	2.913	NA	NA	NA	NA	NA
		n	20		15		27					

Note: $\bar{x}$ = Mean time; s = standard deviation; n = sample size; TFR = Time to First Round; TFH = Time to First Hit
NA = Not Applicable.

Table 9. Timed Measures, M16A1 Rifle (Seconds)

2.7.4.2 M14 Rifle.

a. The results of firing on the standard defense scenario are shown in Table 10.

	Daylight	Moonlight	
Range	Standard	Test	Control
50	4/44 =.091	26/79 =.329	34/70= .486
110	6/61 =.098	12/74 =.162	11/72= .153
130	10/78 =.128	9/119=.076	28/128=.219
190	8/69 =.116	20/141=.142	29/111=.261
220	2/38 =.053	2/102=.020	8/86 =.093
	9/121=.074	9/133=.068	7/101=.069
OVERALL	39/411=.095	78/648=.120	117/568=.206
	(MOVING)		
240	0/147= 0	0/152= 0	0/102= 0
190	0/37 = 0	0/38 = 0	0/26 = 0
OVERALL	0/184= 0	0/190= 0	0/128= 0

NOTES: 1. Each cell shows hits/rounds ratio and hit probability.
2. Starlight conditions did not occur during this phase of testing.

Table 10. M14 Firing Results, Defense Scenario

b. The results of time measurements for first round (TFR) and first hit (TFH) are shown in Table 11.

		Light	Daylight		Moonlight			
		Sight	Standard		Test		Control	
Scenario	Mode	Measure	TFR	TFH	TFR	TFH	TFR	TFH
Standard	Stationary	$\bar{x}$	4.657	6.268	4.710	5.824	4.455	5.599
		s	1.658	2.216	2.140	2.968	2.405	2.542
		n	114	29	179	40	159	67
	Moving	$\bar{x}$	6.264		5.969		6.311	
		s	2.184	NA	2.128	NA	3.295	NA
		n	39		38		32	

Note: $\bar{x}$ = mean time; s = standard deviation; n = sample size; TFR = Time to first round; TFH = Time to first hit; NA = Not Applicable

Table 11. Timed Measures, M14 Rifle (Seconds)

2.7.4.3 M60 Machine Gun.

a. The results of firing on the defense scenario are shown in Table 12.

Range	Daylight Standard	Starlight Test	Moonlight Test
50	2/27 = .074	9/27 = .333	5/13 = .385
110	0/35 = 0	0/8 = 0	5/25 = .200
130	3/38 = .079	2/14 = .143	6/41 = .146
190	0/67 = 0	4/44 = .091	5/34 = .147
220	1/53 = .019	0/13 = 0	7/32 = .219
300	2/81 = .025	2/47 = .043	3/35 = .086
OVERALL	8/301 = .027	17/153 = .111	31/180 = .172

Note: Each cell shows hits/bursts and hit probability.

Table 12. M60 Firing Results, Defense Scenario

b. The results of time measurements for time to first round (TFR) and time to first hit (TFH) are shown in Table 13.

Light	Daylight		Starlight		Moonlight	
Sight	Standard		Test		Test	
Scenario / Measure	TFR	TFH	TFR	TFH	TFR	TFH
Standard $\bar{x}$	4.756	7.739	5.646	5.163	4.489	5.233
s	1.702	3.674	3.983	2.024	2.441	2.329
n	75	8	55	17	42	31

Note: $\bar{x}$ = Mean time; s = standard deviation; n = sample size; FR = First Round; FH = First Hit.

Table 13. Timed Measures, M60 (Seconds)

2.7.4.4 M67 (90-mm Recoilless Rifle). The results of firing on the stationary, moving, and pop-up targets accuracy firing scenarios are shown in Table 14.

Scenario	Stationary		Pop-Up	
Light	Day	Night	Day	Night
Item / Range	Standard	Test	Standard	Test
100	NA	NA	2/2 = 1.000	1/2 = .500
200	11/11 = 1.000	10/11 = .909	1/3 = .333	0/3 = 0
300	10/11 = .909	6/11 = .545	NA	NA
400	5/12 = .417	8/12 = .667	NA	NA
500	0/11 = 0	8/11 = .727	NA	NA
OVERALL	26/45 = .578	32/45 = .711	3/5 = .600	1/5 = .200
	Moving			
200	1/2 = .500	0/2 = 0	NA	NA
300	0/2 = 0	1/2 = .500	NA	NA
400	0/1 = 0	0/1 = 0	NA	NA
OVERALL	1/5 = .200	1/5 = .200	NA	NA

Table 14. M67 Firing Results

2.7.4.5 M72A2 LAW. The results of the stationary and pop-up target accuracy firing scenarios are shown in Table 15.

Scenario	Stationary		Pop-Up	
Light	Day	Night	Day	Night
Item / Range	Standard	Test	Standard	Test
100	20/21 = .952	18/22 = .818	2/2 = 1.000	1/2 = .500
200	15/24 = .625	10/23 = .435	1/3 = .333	0/3 = 0
OVERALL	35/45 = .778	28/45 = .622	3/5 = .600	1/5 = .200

Table 15. M72A2 LAW Firing Results

2.7.4.6 M79 Grenade Launcher. The results of the stationary and pop-up day and night firings with the M79 grenade launcher are shown in Table 16. The number of hits, rounds fired, and hit probabilities for each condition are indicated.

Range (Meters)	Daylight with Standard Sight	Night with AN/PVS-4	Pop-Up
100	7/20 = .350	4/20 = .200	4/4 = 1.000
200	7/20 = .350	6/20 = .300	2/4 = .500
300	7/20 = .350	4/20 = .200	0/2 - .000
TOTAL	21/60 = .350	14/60 = .233	6/10 = .600

NOTE: 1. Brackets for the control sight were not provided.
2. A hit was defined as an impact within a 5-meter radius of target.

Table 16. M79 Firing Results

2.7.4.7 M203 Grenade Launcher. The results of the stationary and pop-up day and night firings with the M203 grenade launcher are shown in Table 17.

2.7.5 Analysis

Range (Meters)	Daylight with Standard Sight	Night with AN/PVS-4	Pop-Up
100	7/20 = .350	5/20 = .250	3/3 = 1.000
200	5/20 = .250	0/20 = .000	3/4 = .750
300	1/20 = .050	0/20 = .000	1/3 = .333
TOTAL	13/60 = .217	5/60 = .083	7/10 = .700

NOTE: 1. Brackets for the control sight were not provided.
2. A hit was defined as an impact within a 5-meter radius of target.

Table 17. M203 Firing Results

2.7.5.1 Details of the statistical analyses are shown at Part II, Appendix A (Test Data). The conclusions of these analyses are shown in subsequent paragraphs by weapon system and are cross-referenced to paragraphs of Part II, Appendix A. Only stationary engagements are included in this analysis due to the low hit probabilities achieved against moving targets.

2.7.5.2 M16A1 Rifle.

a. Defense Scenario.

(1) The HP for the M16A1 rifle with the test sight under moonlight conditions (.208) is not significantly different from the HP with the standard sights under daylight conditions (.282) (para 2a(1)(c), Part II, app A). The HP for the M16A1 rifle with the test sight under starlight conditions (.115) is significantly lower than the HP with the standard sights under daylight conditions (.282) (para 2a(1)(a), part II, app A). Overall, the HP with the test sight (.152) is significantly higher than the HP with the control sight (.112) (para 2a(2)(d), part II, app A).

(2) The M16A1 rifle with the test sight is at least as responsive as the M16A1 rifle with the control sight based on times to first round and times to first hit (para 2a(3), part II, app A).

b. Weight and Balance Scenario.

(1) There is no significant difference in HP when the kneeling position is used with the standard daylight sights under daylight conditions (.078) and the test (.098) or control (.030) sights under moonlight conditions (para 2b(1)(a), part II, app A). When the standing position is used, the HP with the standard sight (.127) and the test sight (.165) are not significantly different, but both are significantly greater than the

HP with the control sight (.071) (para 2b(1)(b), part II, app A). See paragraph 2.11.4.6d.

(2) The M16A1 rifle is equally responsive with either the test or control sights under moonlight conditions (para 2b(2)(a), part II, app A). The M16A1 rifle with the test sight is as responsive as the M16A1 with standard sights except the TFH from the standing position with the test sight is slower (para 2b(2)(b), part II, app A).

2.7.5.3 M14 Rifle.

Defense Scenario.

a. The HP with the M14 rifle with test sight during moonlight (.120) and with the M14 rifle with standard sights under daylight conditions (.095) are not significantly different (para 3a, part II, app A). The HP with the M14 with test sight during moonlight (.120) is significantly lower than the HP with the M14 with control sight (.206) (para 3b, part II, app A).

b. The M14 rifle with the test sight is at least as responsive as the M14 rifle with the control sight based on times to first round and first hit (para 3c, part II, app A).

2.7.5.4 M60 Machine Gun.

Defense Scenario. The HP with the M60 with test sight under moonlight (.172) and under starlight (.111) are respectively greater than and equal to the HP with the M60 under daylight conditions with standard sights (.027) (para 4a(1) and (2), part II, app A).

2.7.5.5 M67 (90-mm Recoilless Rifle). The HP with the M67 and test sight at night (.711) and the M67 with standard sights during daylight (.578) are not significantly different (para 5, part II, app A).

2.7.5.6 M72A2 LAW. The HP with the M72A2 and test sight at night (.622) and the M72A2 with standard sights during daylight (.788) are not significantly different (para 6, part II, app A).

2.7.5.7 M79 Grenade Launcher. The HP for the M79 with the test sight at night (.233) is not significantly different from the HP for the M79 with standard sights under daylight conditions (.350) (para 7, part II, app A).

2.7.5.8 M203 Grenade Launcher.

a. The HP for the M203 with the test sight at night (.083) is significantly lower than the HP for the M203 with standard sights under daylight conditions (.217) (para 8, part II, app A).

b. The significantly lower HP for the M203 under night conditions was due to not being able to zero the M16A1/M203 combination (para 2.6.5.3b) and the design of the mounting bracket (para 2.6.5.1b).

c. The low HP for the M16A1 rifle during starlight conditions, as compared to daylight conditions, is attributed to the low ambient light condition during firing (low band starlight) and the fatigue of the test soldiers.

2.7.5.9 The criterion expressed in paragraph 2.7.2.1 is met by the test sight on all weapons except the M203.

2.7.5.10 The criterion expressed in paragraph 2.7.2.2 is met. The use of the test sight does not adversely affect the weight, balance, firing accuracy, or responsiveness of the weapon systems.

2.8 TRANSPORTABILITY AND PORTABILITY

2.8.1 Objective

To determine the air and ground vehicular-transportability and the man-portability of the test sight.

2.8.2 Criteria

2.8.2.1 (Essential) Item will be transportable by all means of Army transportation including a capability for air delivery (either affixed to the weapon or in an equipment bag) during Phase I of Airborne operations. (item 16, app B)

2.8.2.2 (Essential) Size will be as small as possible, consistent with other characteristics, but must not *** degrade man portability. *** (item 10, app B)

2.8.2.3 (Essential) The sight will be of a configuration such that it will not catch on clothing, brush, low-hanging trees, and the like. (item 13, app B)

2.8.3 Method

2.8.3.1 A 4-day field exercise was conducted under simulated combat conditions. During the exercise, the test soldiers were required to perform

combat tasks which had been identified as being the most important-frequent-difficult tasks performed in combat by Infantry soldiers. These tasks included night reconnaissance and combat patrols during which each of the test items were man-carried over rugged terrain for a cumulative distance of 20 miles over the 4-day period. The protective lens cover was mounted on the sights. The 10 test items were carried 5 miles a day in the following manner:

First day - 5 on the M16A1, 5 on the M14

Second day - 5 on the M79, 5 on the M203/M16A1

Third day - 5 on the M60, 3 on the M72A1, 2 on the M67

On the fourth day of the exercise, five sights were shoulder carried in the vinyl carrying case, and five were carried in a rucksack. During these exercises, 10 test soldiers were required to traverse thickly wooded terrain with dense underbrush, and to cross rivers or streams. Upon completion of the night patrol, the test soldiers simulated conducting a relief in place and observed targets in an array similar to Figure 2, paragraph 2.4.3.1. Upon completion of their observations, the test soldiers confirmed their zeroes according to the procedures outlined in paragraph 2.6.3.3.

2.8.3.2 Five test sights were carried unrestrained in the cargo compartment of a 2-1/2 ton truck, and five test sights were carried unrestrained in an M113 personnel carrier for a distance of 25 miles over unimproved and hard-surfaced roads. All test items were in their shipping containers. After the completion of 25 miles, the test sights were placed into operation and checked for damages.

2.8.3.3 Individual Parachutists:

a. Ten test sights, each in its individual vinyl carrying case, were placed in 10 each parachutists' kit bags with "H harness." Each test sight was jumped 4 times. The parachutists were required to make a parachute landing fall to the front, rear, right, and left. After each jump, the test sight was placed into operation and examined for damage.

b. A test sight was placed in its vinyl carrying case and subsequently placed in an Adjustable Individual Weapons Case, M1950, with an M16A1. The above combination was jumped 4 times. The parachutists were required to make parachute landing falls to the front, rear, right, and left. After each jump, the test sight was placed into operation and examined for damage.

2.8.3.4 Ten test soldiers, carrying their fighting load, were equipped with the following weapons (with test sights mounted):

a. 2 each M16A1

b. 2 each M14

c. 2 each M79

d. 2 each M203

e. 1 each M60

f. 1 each M67

The two men equipped with the M16A1's had an M72A1 slung onto their back (with the test sight mounted). Consistent with the load carrying capability of the aircraft, these men were loaded into, air lifted, and off loaded from a UH-1 helicopter. The exercise was repeated until each man had made 10 simulated combat assaults in daylight and darkness. After each combat assault, the test sight was placed into operation and checked for damage.

2.8.3.5 Each test sight was zeroed to an M16A1 before the testing described in paragraphs 2.8.3.2, 2.8.3.3, and 2.8.3.4 was conducted. After testing was completed for the day, the test sight was mounted on its weapon, and the known distance target method of zeroing (described in paragraph 2.6.3.3b) was performed. Confirmation rounds were fired from each weapon. The zero was also cross checked by counting the clicks of elevation and deflection.

2.8.4 Results

2.8.4.1 The test sights in their shipping containers withstood rough handling associated with transportation in the cargo compartment of Army vehicles. Upon completion of the exercise in paragraph 2.8.3.2, there was no effect on the zero of any of the test sights.

2.8.4.2 The test sight was successfully delivered in Phase I of Airborne operations by being jumped by an individual parachutist (44 times) and in airmobile assaults. Experienced parachutists judged that it was not feasible or practical to deliver the sight affixed to the weapon by an individual parachutist.

2.8.4.3 Upon completion of the exercise described in paragraph 2.8.3.3 and 2.8.3.4, there was no effect on the zero of any of the test sights.

2.8.4.4 The test sight, when mounted on the weapons listed in paragraph 2.8.3.1, did not substantially degrade man portability. The weapon/sight combination did to some extent catch on brush, vines, and branches, but this is considered minimal.

2.8.4.5 There was no noticeable difference of the test sight changing the center of balance of any weapon/sight combination.

2.8.4.6 Upon completion of the exercise described in paragraph 2.8.3.1, there was no effect on the zero of any of the test sights.

2.8.4.7 The P(R) achieved during tactical observations after the relief in place are shown in Table A-24, Part III, Appendix A. The overall P(R) was 150/224 = .669. The P(R) was compared to the P(R) for moonlight and starlight combined reported in Table A-6, Part III, Appendix A (para 2.4) (1295/2013 - .643). This comparison was by a Hald Proportion Test at the .10 level of significance. There was no significant difference in the P(R)'s. This indicates that there was no degradation in capability to recognize targets after limited field use.

2.8.4.8 After a parachute operation, one test sight was reported inoperable. The DS repairman indicated that the image intensifier tube was defective and replaced it. The sight was operable before the parachute operation. The damage to the sight indicates a lack of durability and is not necessarily attributed to the parachute operation. (See paragraph 2.9.5.5b.)

2.8.5 Analysis

2.8.5.1 The test item can be transported by all means of Army transportation, including air delivery during Phase I of Airborne operations.

2.8.5.2 The size is small as possible, consistent with other characteristics, and does not degrade man portability.

2.8.5.3 The sight did catch on clothing, brush, or low-hanging trees and the like to some extent, but this is considered acceptable.

2.8.5.4 The test item meets the criteria stated in paragraphs 2.8.2.1, 2.8.2.2, and 2.8.2.3.

2.9 RELIABILITY AND DURABILITY

2.9.1 Objective

To determine the degree of reliability and durability of the test item and the accessories.

2.9.2 Criteria

2.9.2.1 (Essential) Sight must stand the shock of repeated firings without damage or change of adjustment. (item 18, app B)

2.9.2.2 Durability. (Essential) Sight must withstand rough handling associated with transportation and use during combat operations. Normal combat life of this item (mean time between failure not including maintenance requirements) will be 1000 operating hours, 2000 operating hours (Desirable). (item 12, app B)

2.9.2.3 (Essential) *** Minimum battery life will be such that the sight can be operated continuously for at least 12 hours without replacement. *** (item 17, app B)

2.9.2.4 (Essential) The eyepiece and lens will be protected against fogging either from moisture generated by body heat or by humid conditions. (item 14, app B)

2.9.3 Method

2.9.3.1 Reliability and durability data were collected concurrently with other subtests. During Subtest No 7, Accuracy, specific note was made to determine whether the test sight was sufficiently durable to withstand the shock of repeated firing without damage or change of adjustment. Special attention was given to the detection of fogging and the collection of moisture on the test items.

2.9.3.2 For reliability evaluation, a failure was defined as any malfunction which the operator/crew could not remedy by adjustment, repair, or replacement action using the controls, OEM tools, and OEM parts within 10 minutes and which caused or may have caused:

a. Failure to commence operation, cessation of operation, or degradation of performance capability of system/subsystem below designated levels.

b. Serious damage to system/subsystem by continuous operation. Simultaneous related malfunctions were considered as one failure. Malfunctions that did not affect mission performance were not considered failures.

2.9.3.3 No scoring criteria, operational mode summary, or mission profile were applicable.

2.9.3.4 A record was maintained on battery life throughout the test. The test sights were operated with only one battery at a time during all phases of testing except accuracy firing, when two batteries were used.

2.9.3.5 During periods of high humidity, mist, or rain, defogging compound was applied to the lens and eyepiece.

2.9.4 Results

2.9.4.1 During firing with the test item and weapons, two failures occurred. One image intensifier tube failed, and a terminal broke on the tube brightness control. The number of rounds fired is shown in Tables A-20 and A-21, Part III, Appendix A.

2.9.4.2 The number of operating hours and chargeable failures are shown in Table 18 and Tables A-22 and A-23, Part III, Appendix A, for each test sight by serial number. There were 17 failures in 5775.28 hours of operation.

2.9.4.3 There were 20 maintenance actions requiring logistic resources. These actions and resources are detailed in Appendix D, Maintenance Evaluation.

2.9.4.4 The results of zero retention are shown in paragraph 2.6.4.8.

2.9.4.5 The mean battery life was 32.2 hours.

2.9.4.6 The defogging compound provided adequate protection from eyepiece and lens fogging.

2.9.5 Analysis

2.9.5.1 The criterion in paragraph 2.9.2.1 is met. The large number of and type rounds fired with the test items with only two failures is considered insignificant.

2.9.5.2 The failures shown in Table 18 are chargeable failures for the following reasons:

a. Image Intensifier Tubes (5). These faulty tubes rendered the sights inoperable and were unrepairable by the operators.

b. Objective Lens (2). These defects rendered the sights inoperable and were unrepairable by the operators.

c. Eyeguard Body (4). The separation of the eyeguard body from the sight rendered the sight unusable because the safety release specified the rubber eye shield must remain in position during all firing to prevent head and eye injury.

SIGHT SN	OPERATING HOURS (1)	NO OF CHARGEABLE FAILURES	TYPE FAILURES	EPI NO
120	184:18	1	Eyeguard body separation. Repaired at organizational maintenance	None
121	225:35	1	Defective Image Intensifier Tube. Replaced at DS maintenance.	23(5-3)
122	185:20	1	Defective Objective Lens. Replaced at DS maintenance.	21
124	255:25	1	Defective Image Intensifier Tube. Replaced at DS maintenance. (2)	25(5-4)
124	:05	1	Loss of Reticle Pattern. Defective Illuminator Assy. Replaced at DS.	2
124	198:10	1	Defective Objective Lens. Replaced at DS maintenance.	16
124	198:20	1	Eyeguard body separation. Replaced at Organ.Maintenance.	20(6-3)
125	30:18	1	Loss of Display. Adjustment at DS maintenance.	7
125	134:38	1	Defective Image Intensifier Tube. Replaced at DS maintenance.	10(5-2)
125	139:54	1	Eyeguard body separation. Replaced at Organ.Maintenance.	14(6-1)
125	179:00	1	Eyeguard body separation. Replaced at Organ.Maintenance.	15(6-2)
126	16:11	1	Defective Image Intensifier Tube. Replaced at DS maintenance.	5
126	341:10	1	Defective Reticle Cell. Replaced at DS maintenance.	28
126	410:40	1	Broken connector wires to Image Intensifier Tube and Tube Brightness Control. Repaired at DS maintenance.	29
127	11:35	1	Loss of gain on brightness tube on/off control. Repaired at DS maintenance.	4
127	61:25	1	Defective Image Intensifier Tube. Replaced at DS maintenance.	8(5-1)
128	376:30	1	Broken terminal on tube brightness on/off switch. Repaired at DS maintenance.	27

(1) Total operating hours and minutes at failure.
(2) Damaged during parachute operation.

Table 18. Test Sight Reliability Data

d. Illuminator Assembly (1). Loss of reticle pattern illumination renders the sight inoperable and unrepairable by the operator.

e. Broken Terminals or Wires (2). These broken electrical components render the sight inoperable and unrepairable by the operator.

f. Loss of Display/Gain and Defective Reticle Cell (3). These incidents were unrepairable by the operator within 10 minutes and required either replacement or adjustment at DS maintenance.

2.9.5.3 The failures of the AN/PVS-4 sight are assumed to be exponentially distributed. The point estimate of mean time between failure (MTBF) was computed as:

$$\text{MTBF} = \frac{\text{Total Operating Time}}{\text{Number of Chargeable Failures}} = \frac{5775.28}{17} = 339.74 \text{ or } 340 \text{ hours}$$

2.9.5.4 The 2-sided 80-percent confidence interval about the MTBF point estimate was computed as:

$$\frac{2T}{X^2\ .10;\ 2n+2} \leq \text{MTBF} \leq \frac{2T}{X^2\ .90;\ 2n}$$

$$\frac{2(5775.28)}{X^2\ .10;36} \leq \text{MTBF} \leq \frac{2(5775.28)}{X^2\ .90;34}$$

$$245 \text{ hours} \leq \text{MTBF} \leq 483 \text{ hours}$$

2.9.5.5 With respect to durability and reliability:

a. The AN/PVS-4 sight MTBF of 340 hours represents a significant improvement in reliability over the 44 hours found during Service Test.

b. The AN/PVS-4 sight does not meet the durability criterion in paragraph 2.9.2.2 since there were 4 eyeguard body separations, 2 broken electrical terminals or wires, and one defective image intensifier tube. The eyeguard body separations and broken connections can be directly attributable to lack of durability. The image intensifier tube was damaged during

a parachute operation and indicates a lack of durability. (See Table A-21, Part III, Appendix A, and paragraph 2.8.4.8.

c. This lack of durability and reliability is classified as a deficiency since it seriously impairs the operational capabilities of the sight and decreases user availability.

2.9.5.6 The criterion in paragraph 2.9.2.3 is met.

2.9.5.7 The criterion in paragraph 2.9.2.4 is met.

2.10 MAINTENANCE EVALUATION

2.10.1 Maintainability Indices

2.10.1.1 Objective. To record the pertinent data enabling the evaluation and assessment of the maintenance/maintainability characteristics of the test sight and its related materiel.

2.10.1.2 Criteria

a. Operator maintenance will consist of care and cleaning, minor adjustments and changing of batteries. Other organizational maintenance will be accomplished by company armorers and will be limited to changing of modules. (item 25, app B)

b. No additional personnel will be required for first and second echelon maintenance. (item 35, app B)

c. Necessary maintenance package will be provided with service test models in accordance with AR 750-1, para 2-23. (item 29, app B)

d. Minimum number and complexity of maintenance tasks (i.e., calibration adjustments inspection). (item 30(1), app B)

2.10.1.3 Method

a. Throughout the conduct of the test, required data was collected during the performance of scheduled and unscheduled maintenance action. This data is recorded on the applicable chart as required by TECOM Supplement 1 to AR 750-1.

b. Based on the above data, the following computations will be made in accordance with TECOM Supplement 1 to AR 750-1:

(1) Mean Time to Repair (MTTR).

(2) Maintenance Ratio (MR).

(3) Achieved Availability (A_a).

c. Operator and organization maintenance tasks were limited to those operations allocated on the Maintenance Allocation Chart (MAC). These operations were performed either in direct support of the test (corrective maintenance) or during scheduled maintenance services. All maintenance was performed in accordance with procedures prescribed in the appropriate maintenance literature by personnel with the appropriate MOS (76Y).

2.10.1.4 Results

a. Operators were able to inspect, clean, replace batteries, and install daylight covers and weapon adjustors without difficulty. Organizational repairman replaced components/modules such as eyeshields, weapon adapters, and daylight covers without difficulty.

b. Due to the limited maintenance authorized at operator and organizational levels, no additional personnel were required to maintain the AN/PVS-4.

c. A maintenance test package consisting of equipment publications, repair parts, and tool kits (TK-101 and TK-105G) was provided with the AN/PVS-4.

d. The maintenance tasks required to maintain the AN/PVS-4 at organizational and DS/GS level are not difficult. This sight requires no calibration adjustments.

e. Maintenance statistics are tabulated in Table 19.

f. The Maintenance Analysis Charts are shown in Appendix D, Maintenance Evaluation.

2.10.1.5 Analysis

a. The criterion stated in paragraph 2.10.1.2a is met. The operator and organizational maintenance repairman (company armorer) were able to perform all tasks assigned by the Maintenance Allocation Chart (MAC). It is recommended that the installation of the reticle cell be allocated to the organizational repairman. This task does not require great skill, and no special tools are required. It is further recommended, as an added

improvement, that the hole in the reticle cell used for setting the cell be redesigned as a recessed slot at the edge of the cell to facilitate performance of this maintenance task at organization level.

b. The criterion stated in paragraph 2.10.1.2b is met. No additional personnel are required for first and second echelon maintenance.

c. The criterion stated in paragraph 2.10.1.2c is met. The necessary maintenance test package was provided.

d. The criterion stated in paragraph 2.10.1.2d is met. No complex maintenance tasks were encountered.

MAINTENANCE LEVEL	MTTR (HOURS)	MR (HOURS)	A_a (HOURS)
Organizational	$.9/_{4} = .225$	$3.7/_{5775.28} = .001$	$5775.28/_{5788.58} = .998$
Direct Support	$9.1/_{18} = .535$	$9.6/_{5775.28} = .002$	
Overall	$10.0/_{21} = .476$	$13.3/_{5775.28} = .002$	

Notes:

1. MTTR = $\frac{\text{Total Corrective Maintenance Time}}{\text{Total Number of Malfunctions Requiring Corrective Maintenance.}}$

2. MR = $\frac{\text{Total Corrective and Preventive Maintenance Manhours}}{\text{Total Operating Test Time.}}$

3. A_a = $\frac{\text{Total Operating Time}}{\text{Total Operating Time + Preventive and Corrective Maintenance Time.}}$

Table 19. AN/PVS-4 Sight Maintenance Statistics

2.10.2 Tools and Test Equipment

2.10.2.1 Objective. To determine whether the tools and test equipment are suitable and needed for the intended purpose and prescribed maintenance level.

2.10.2.2 Criteria

a. Requirements for special test equipment will be minimized insofar as possible. Maintenance characteristics will be made compatible with existing electronic test equipment, tools, and procedures. (item 26, app B)

b. Weapons sight kits will include necessary tools for operator maintenance and one spare battery. If possible, the universal tool or tools issued with applicable weapons will be used. (item 28, app B)

c. Use built-in testing and calibration equipment for parts and components wherever feasible. (item 30(10), app B)

2.10.2.3 Method. All tools of tool kits TK-105G and TK-101 required to service and repair the AN/PVS-4 were evaluated. Repairmen conducting maintenance were required to use tools and test equipment as stated in applicable manuals.

2.10.2.4 Results

a. No special test equipment was required for repairing or troubleshooting the AN/PVS-4 at DS/GS maintenance level. A standard multimeter (TS-352-BU) was used to make continuity checks and check values of resistance when electrical problems were suspected.

b. Tools and running spare batteries required by operator were available.

c. Built-in testing and calibration equipment was not on the AN/PVS-4 and was not required.

d. Tools and test equipment performed the operation for which designed; however, the number 1 Phillips screwdriver in the 35E repairman's tool kit is too large. Prolonged use of this screwdriver on screw, machine (Figure 8, item #5, page I-24, Draft TM 11-5855-213-34P, Jan 1974) causes the screw face/slots to become rounded/distorted.

e. Tools and test equipment issued were prescribed at the appropriate maintenance level.

f. Draft TM instructions pertaining to tools and test equipment are considered adequate.

g. The Special Tool and Equipment Chart is shown in Appendix D, Maintenance Evaluation.

2.10.2.5 Analysis

a. The criterion in paragraph 2.10.2.2a is met. The maintenance characteristics of the AN/PVS-4 sight are compatible with existing electronic test equipment, tools, and procedures, and there is no requirement for special test equipment.

b. The criterion in paragraph 2.10.2.2b is met. The weapons sight kit included necessary tools and batteries for operator maintenance.

c. The criterion in paragraph 2.10.2.2c is met. Although test and calibration equipment is not built into the AN/PVS-4 sight, this capability did not appear feasible and was not required. Adequate trouble shooting procedures are provided in the appropriate maintenance literature.

d. It is recommended that a cross tip screwdriver, Phillips #00, be added to the 35E repairman tool kit for use in removal or replacement of the screws on the image intensifier tube of the AN/PVS-4 night sight.

2.10.3 Equipment Publications

2.10.3.1 Objective. To determine whether the equipment publications contain the essential operating and maintenance information and comply with the regulations and military standards prescribing format, content, and standards for production of technical manuals.

2.10.3.2 Criteria

a. *** Appropriate manuals detailing operating and maintenance procedures will be provided. (item 31, app B)

b. Draft or preliminary maintenance manuals provided with the test item will comply with the appropriate regulations and military standards prescribing format, content, and standards for production of technical manuals. (item 45, app B)

2.10.3.3 Method

a. The equipment publications were reviewed to determine whether they reflect the system they support and whether they were complete, accurate, and understandable by the personnel who will use them.

b. The equipment publications provided in the maintenance test package for the test item were reviewed for format, content, and standards

as prescribed by current regulations and military standards for production of technical manuals.

c. Maintenance operations were performed as outlined in the appropriate manual to determine whether instructions were clear and in sequence and whether they were adequate for the training level possessed by appropriate maintenance personnel.

2.10.3.4 Results

a. The following maintenance publications were provided for the test:

(1) DTM 11-5855-213-12, Draft Operator and Organizational Maintenance Manuals for the AN/PVS-4.

(2) DTM 11-5855-213-34, Draft Direct and General Support Maintenance Manual for the AN/PVS-4.

(3) DTM 11-5855-213-20P, Repair Parts and Special Tools List for Organizational Maintenance for the AN/PVS-4.

(4) DTM 11-5855-213-34P, Repair Parts and Special Tools List for Direct and General Support Maintenance for the AN/PVS-4.

b. All manuals complied with the format prescribed by military standards.

c. The manuals were not accurate and consistent within themselves in that they were not accurate in identifying numerous items and parts referenced. The two technical manuals dealing with repair parts and special tools list were poorly organized; the repairman was required to make a concentrated effort to determine the nomenclature and federal stock number (FSN) on numerous parts. The Maintenance Package Literature Chart is shown in Appendix D, Maintenance Evaluation.

2.10.3.5 Analysis

a. The criterion stated in paragraph 2.10.3.2a is met. Manuals detailing operating and maintenance procedures are provided.

b. The criterion stated in paragraph 2.10.3.2b is not met. The manuals were not accurate in identifying numerous items and parts. This is a shortcoming.

2.10.4 Repair Parts

2.10.4.1 Objective. To obtain repair parts usage data and to assist in the determination of required logistics support for the test item.

2.10.4.2 Criteria

a. Skill and time required for repair of this sight will be minimized. (item 27, app B)

b. Use modular or throw-away components, assemblies or parts where economical and practicable. (item 30(9), app B)

c. Design for rapid and positive identification of the replaceable defective component, assembly, or part. (item 30(3), app B)

2.10.4.3 Method. Maintenance operations were observed and difficulties in removal, installation, alignment, and interchangeability of repair parts were noted. Parts peculiar to the test item were checked to determine whether they can be replaced with similar parts now in the supply system.

2.10.4.4 Results

a. The AN/PVS-4 sight was modular but, due to the cost, the major components are repairable/recoverable items as opposed to throw-away components.

b. There were no test procedures which allowed for rapid and positive identification of defective components. The repairman had to either substitute known good components for suspect components or disassemble the system to make electrical checks. In either case, the system had to be disassembled prior to fault isolation.

c. Personnel experienced difficulty in removing the mounting brackets from weapons. This problem may be due to a cross binding between two metal surfaces, thus causing cross threading. The result was the twisting off of five mounting knobs.

d. The Repair Parts Analysis Charts are shown in Appendix D, Maintenance Evaluation.

2.10.4.5 Analysis

a. The criterion stated in paragraph 2.10.4.2a is met. Skills required were that of the organizational/DS maintenance repairman. Maximum time to remove and replace any one component did not exceed .3 hour.

b. The criterion stated in paragraph 2.10.4.2b is met. The test sight is modular in construction.

c. The criterion in paragraph 2.10.4.2c is not met. The sight does not permit rapid and positive identification of defective components. Defective components are identified by substitution of serviceable parts. This is a shortcoming. (See paragraph 2.10.5.5b.)

2.10.5 Design for Maintainability

2.10.5.1 Objective. To evaluate the ease with which the test item can be maintained.

2.10.5.2 Criteria. The following maintenance factors will be considered:

a. Design to minimize the numbers and types of tools and test equipment (special and standard) required to perform maintenance. (item 30(5), app B)

b. Design for rapid and positive recognition of malfunction or marginal performance. (item 30(2), app B)

c. Design to minimize maintenance personnel skills and training requirements. (item 30(4), app B)

d. Designs for optimum accessibility in all systems, equipments, and components requiring maintenance, inspections, removal, or replacement. (item 30(6), app B)

e. Design to minimize the net mean time required to accomplish scheduled and unscheduled maintenance to assure operational availability. (item 30(8), app B)

f. Design to permit accomplishment of maintenance operation in the shortest possible time under adverse working conditions. (item 30(11), app B)

2.10.5.3 Method. Maintenance operations were monitored continuously for indications that the equipment design is directed toward minimizing maintenance (i.e., fault isolation indicators, ease of access of components, modular construction).

2.10.5.4 Results

a. The AN/PVS-4 required seven common tools to perform all tasks authorized by the DS repairman and no tools at the organizational level.

The standard Army multimeter (TS-352-BU) was used to perform continuity checks.

b. There was no rapid method for determining malfunctioning components or assemblies. In order to troubleshoot the system, the repairman must disassemble the scope for electrical continuity checks and parts substitution.

c. The organizational and DS repairmen were able to repair the AN/PVS-4 with minimum new equipment training. They experienced no difficulty in understanding the system and how it functioned.

d. Components of the AN/PVS-4 were readily accessible. All components authorized to be serviced by the DS repairman were removed in a matter of 12-15 minutes.

e. The overall corrective maintenance time at the organizational and DS maintenance level was .464 hour.

f. The AN/PVS-4 was not designed to be repaired under adverse conditions at DS maintenance level. At organizational level, the repairman is able to accomplish his assigned tasks.

2.10.5.5 Analysis

a. The criterion stated in paragraph 2.10.5.2a is met. The sight is designed to minimize the numbers and types of tools required to maintain it.

b. The criterion stated in paragraph 2.10.5.2b is not met. The design does not offer a rapid and positive means to identify malfunctions or marginal performance. This was previously classified as a shortcoming in paragraph 2.10.4.5c.

c. The criterion stated in paragraph 2.10.5.2c is met. The sight is designed to minimize maintenance personnel skills and training requirements.

d. The criterion stated in paragraph 2.10.5.2d is met.

e. The criterion stated in paragraph 2.10.5.2e is met.

f. The criterion stated in paragraph 2.10.5.2f was not tested. However, no optical sighting equipment is designed to be maintained under adverse conditions.

2.10.6 Safety Aspects of Maintenance Operations

2.10.6.1 Objective. To determine if the test sight can be maintained safely.

2.10.6.2 Criterion. Design for maximum safety and protection for both equipment and personnel involved in the performance of maintenance. (item 30(7), app B)

2.10.6.3 Method. Safety aspects of maintenance functions performed throughout the conduct of the test of the AN/PVS-4 sight were observed. Safety inspections were performed and findings recorded. The inspections were performed to determine that adequate safety features were provided when required, and whether working plates and instruction plates were adequate and conspicuously positioned.

2.10.6.4 Results. There were no maintenance or equipment safety hazards observed during the test.

2.10.6.5 Analysis. The criterion in paragraph 2.10.6.2 pertaining to safety aspects of maintenance is met.

2.10.7 Human Factors Aspect of Maintenance Operations

2.10.7.1 Objective. To determine the capability of the maintenance personnel to maintain the test sights.

2.10.7.2 Criterion. The equipment will be considered as a component of a man-machine system and will be developed with full consideration for the intellectual, physical, and psychomotor capabilities of the intended user and maintenance personnel. (item 31, app B)

2.10.7.3 Method. Maintenance personnel were observed and questioned to determine their ability to maintain the test sight.

2.10.7.4 Result. Organizational and DS repairman personnel experienced no difficulty in maintaining or repairing the AN/PVS-4.

2.10.7.5 Analysis. The criterion stated in paragraph 2.10.7.2 pertaining to human factors aspect of maintenance operations is met.

2.11 HUMAN FACTORS

2.11.1 Objective

To determine whether the test item is designed in accordance with good human factors engineering.

2.11.2 Criteria

2.11.2.1 The equipment will be designed in accordance with good human factors engineering practice. *** Arrangement, size, and shape of operator control will permit ready tactile identification and adjustment in darkness. *** (item 31, app B)

2.11.2.2 The weight and balance of the sight will be such as to minimize operator fatigue. *** (item 32, app B)

2.11.2.3 Suitable methods will be developed for carrying the sight when it is not attached to the weapon. The sight case will be provided with straps or clips so that it can be carried on a fully equipped combat soldier's web equipment or over his shoulder. This will be done with minimum adverse effect to the load carrying capacity, mobility, and freedom of operation of the individual soldier. (item 33, app B)

2.11.2.4 (Essential) Access to knobs or switches will be convenient from any of the normal firing positions. Adjustment will be practicable for an operator wearing gloves. *** (item 22, app B)

2.11.3 Method

2.11.3.1 This subtest was conducted concurrently with all testing.

2.11.3.2 Throughout testing, data was collected by means of test supervisory personnel observations, and interviews and questionnaires administered to test soldiers.

2.11.3.3 An interview (pages A-IV-1 thru A-IV-4, app A) was administered to test soldiers during Subtest 4, Tactical Observation. This interview was designed to elicit test soldier opinions and observations concerning the use of the test item as an aid to observation.

2.11.3.4 An exercise was conducted to obtain times required for operations listed below, once when the test soldiers were wearing temperate climate gloves (standard issue five-finger gloves with liners) and once with the test soldiers were wearing arctic gauntlet mittens:

a. "Into operation" time was obtained for test soldiers and included removing the test item and fabric case from the solid case, removing the fabric case from the test item, emplacing two batteries in the test item, turning on and adjusting the tube brightness, turning on and adjusting the reticle brightness, adjusting the diopter ring, and adjusting the range focus ring.

b. "On" time was obtained for test soldiers attaching the mounting bracket to the weapon, and the test item to the bracket.

c. "Off" time was obtained for test soldiers removing the test item from the bracket and the bracket from the weapon.

2.11.3.5 Interviews (pages A-IV-5 and A-IV-6, app A) were administered to participating test soldiers and observations were made during Subtest 8, Portability and Transportability.

2.11.3.6 A questionnaire (pages A-IV-7 thru A-IV-14, app A) was administered to test soldiers during Subtest 7, Accuracy.

2.11.3.7 At the conclusion of physical testing, an eye-fatigue exercise was conducted in which test soldiers simulated the extended uninterrupted observation times of a combat environment. Times for the following events were obtained: time to first report of eye fatigue, length of rest period, and time to second report of eye fatigue.

2.11.4 Results

2.11.4.1 The results of the tactical observation interview are shown on pages A-IV-1 thru A-IV-4, Appendix A.

a. Four of ten test soldiers reported that their eyes felt different after extended observation with the test item. Four test soldiers also reported that their eyes felt different after extended observation with the control item. Further comments indicated similar symptoms of eye fatigue for both sights: eyes "hurt, watered, ached, jumped, or vision appeared fuzzy." Eye fatigue was further evaluated in a simulated combat observation exercise (para 2.11.4.5). Irritation of the skin of the eyebrow and eye socket from pressure of the rubber eye cup was also mentioned (questions 1-3, page A-IV-1, app A).

b. Four of ten test soldiers indicated that they had difficulty adjusting starlight scope controls of test and control items to suit their eyes. One test soldier reported difficulty adjusting the test item range focus ring, and two test soldiers reported binding of the control item range focus ring (questions 4 and 5, page A-IV-1, app A).

c. Nine of the ten test soldiers reported no physical discomforts other than the preceding (para 2.11.4.1a) during or after use of both the test and control items (questions 6-8, page A-IV-2, app A).

d. One of the ten test soldiers reported that he was able to see targets near a bright light source using the control item. Four of ten test soldiers reported that they were able to see targets near a bright light source using the test item. Nine of ten test soldiers considered the test item sight picture to be less affected by the bright light source than the control item sight picture. The bright light sources were helicopter lights passing overhead and headlights of support vehicles passing behind or beside target personnel.

e. Seven of ten test soldiers reported no difficulties in barehanded control adjustment at night. One test soldier reported difficulty focusing both test and control items. One test soldier expressed a need for a tool to adjust test item reticle position (azimuth and elevation).

f. Seven of ten test soldiers reported that the test item produced a clearer, more detailed picture than the control item. Two test soldiers reported that the control item produced a clearer, more detailed picture. One test soldier preferred the control item for close ranges and the test item for long ranges (question 12, page A-IV-3, app A).

g. Nine of ten test soldiers considered the levels of brightness produced by the test item "better" than that of the control item (question 13, page A-IV-4, app A).

h. Nine of ten test soldiers preferred to use the test item for extended night tactical observation (question 14, page A-IV-4, app A).

2.11.4.2 Tables 20, 21, and 22 show the operational times obtained for daylight use of the test item by test soldiers wearing temperate climate cold weather gloves (five finger) and liners, and while wearing arctic mittens (three finger). "Into operation" time was obtained for test soldiers performing the following operations: removal of test item inside fabric case from solid case, removal of the fabric case from test item, emplacement of two batteries in the test item, turning on and adjusting tube brightness, turning on and adjusting reticle brightness, adjustment of diopter ring, and adjustment of range focus ring. "On" time was obtained for test soldiers attaching the mounting bracket to the weapon, and the test item to the bracket. "Off" time was obtained for test soldiers removing the test item from the bracket and the bracket from the weapon.

2.11.4.3 Observations were made and an interview was administered to participating test soldiers following daylight portability and transportability exercises using the M72A2, M60, M67, M79, M203, M14, and M16A1.

	Times to Mount and Dismount (Seconds)											
	M16A1		M14		M203		M79		M60		M72A2	
	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF
Mean	39.7	21.6	23.4	19.8	64.2	33.6	67.3	67.7	210.3	218.1	96.2	44.4
S. D.	30.4	9.9	14.5	11.3	42.7	17.5	24.6	22.0	179.2	220.4	64.9	55.8

NOTE: Times were extracted from Subtest No 6.

Table 20. Operational Times for Test Soldiers Not Wearing Temperate Climate Gloves and Liners

		Times to Mount and Dismount (Seconds)										
	Into-Operation Time	M16A1		M14		M203		M79		M60		M72A2
		ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	
Mean	89.55	83.03	*15.47	*170.47	44.62	85.96	33.28	113.61	61.11	212.10	124.28	**
S. D.	45.50	27.79	11.90	95.57	20.20	39.04	21.77	50.34	17.16	87.93	51.14	**

* One

** M72A2 was not available. Time in seconds.

Table 21. Operational Times for Test Soldiers Wearing Temperate Climate Gloves and Liners

		Times to Mount and Dismount (Seconds)										
	Into-Operation Time	M16A1		M14		M203		M79		M72A2		M60
		ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	
Mean	73.60	74.53	20.77	169.69	71.91	112.92	33.01	129.21	107.03	71.26	18.54	*
S. D.	23.43	53.35	24.61	80.32	24.93	35.93	12.96	65.03	43.62	24.48	7.31	*

(Note: Sample size for all weapons was 9)

*Time was stopped when three test soldiers could not proceed further with insertion of feed tray cover pin after 10 minutes of attempts to insert pin. Time in seconds.

Table 22. Operational Times for Test Soldiers Wearing Arctic Mittens

Note: The preceding times were obtained approximately sixty days apart under differing conditions of training and motivation. Tactically feasible operational time is demonstrated.

The following comments were submitted by test soldiers and test supervisory personnel:

a. Three test soldiers reported that the M67 breech and breech handle caught on brush and vines more frequently than did the mounted test item. Test soldier suggestions for improvement of the test item and M67 system include: reduction of the diameter of the test item and modification of the fabric carrying case to permit coverage of the test item in mounted position (questions 1 and 2, page A-IV-6, app A).

b. One test soldier reported that the M60 and test item system snagged on brush at the front of the bracket three times, but the M60 itself was a worse source of snagging (question 1, page A-IV-5, app A).

c. The test item and M72A2 system did not snag on anything. Test soldier suggestions for improvement of the system included the statement that a smaller size (diameter and length) item which achieved the same visual performance would be desirable (questions 3 and 4, pages A-IV-5, app A).

d. The test item/M16A1 and test item/M14 systems were observed to catch on brush and vines but not with high frequency, nor in such a way as to create a major impediment to movement.

e. The test item with the M203 and test item with the M79 systems were not observed to snag on brush or vines.

f. The equipment attachment clips on the test item fabric carrying case were adequate to attach and carry the test item on the web belt.

g. The carrying case straps were used to attach the fabric case to load-carrying gear or were tied and used as a sling. The straps were adequate for attachment to load-carrying gear but were too short for comfortable extended sling-carry because they could not be positioned diagonally across the body. As used in this portability exercise, the sling-carry required that the test soldier maintain one hand on the sling at least part of the time.

2.11.4.4 The results of the questionnaire administered during Subtest 7, Accuracy, were not statistically tested due to the limited sample size (9) (pages A-IV-7 thru A-IV-14, app A). (Only 9 test soldiers were available to complete the questionnaire.)

a. All the test soldiers considered the test item "easy" or "very easy" to use. Eight of nine test soldiers considered the control item "easy" or "very easy" to use (questions 1 and 2, page A-IV-7, app A).

b. Seven of nine test soldiers reported that there was no difference between the amount of eye fatigue produced by the control item and the test item (question 3, page A-IV-7, app A).

c. Eight of nine test soldiers reported that the test item permitted the most stable and comfortable grip. One test soldier reported no difference (question 4, page A-IV-8, app A).

d. All test soldiers considered the brightness control of the test item a positive asset in obtaining a good sight picture. There was no consensus regarding the best method of regulation of tube brightness (questions 5 and 6, page A-IV-8, app A).

e. Six of nine test soldiers reported that the test item would not enable them to see through haze. One of the three test soldiers who reported that the test item would penetrate haze compared it favorably to the control item (question 7, page A-IV-8, app A).

f. There was no consensus regarding the best method of using the test item objective focus ring. Four test soldiers reported that they continuously adjusted the focus each time they observed a target array (question 8, page A-IV-9, app A).

g. Seven of nine test soldiers considered the following controls conveniently located and sensitive to touch: tube brightness/off-on switch, and reticle brightness control. Eight of nine test soldiers considered the following controls conveniently located and sensitive to touch: the diopter ring and the range focusing ring. All test soldiers reported that the range focusing ring was easy to locate in the dark (questions 9 and 10, page A-IV-9, app A).

h. Five of nine test soldiers reported eye fatigue during prior observation exercises. Two test soldiers related eye fatigue to firing, but no solid relationship could be established between eye fatigue and any type of terrain or ambient light condition (questions 11 and 12, pages A-IV-9 and A-IV-10, app A).

i. Seven of nine test soldiers reported lens fogging while using both the test and control items (question 13, page A-IV-10, app A). This condition was overcome by antifogging compound (ref para 2.9.3.5).

j. Six of nine test soldiers reported no difficulty identifying any controls in the dark with either the test or control items (question 14, page A-IV-10, app A).

k. All three test soldiers who wore glasses considered the test item incompatible with eyeglasses. The method used most frequently by eyeglass wearers was to remove their glasses and adjust the diopter ring to compensate for their visual disability (question 15, page A-IV-11, app A).

l. Six of nine test soldiers reported that the wider field of view of the test item did not change their ability to detect targets (questions 16 and 18, pages A-IV-11 and A-IV-12, app A).

m. Three test soldiers reported that scintillation (snowy screen) in either test or control item impaired their ability to observe. They reported that it made target observation more difficult (question 17, page A-IV-10, app A).

n. One test soldier reported that the test item had the most scintillation. Three test soldiers reported that the control item had the most scintillation. Five test soldiers did not report scintillation on either scope (question 19, page A-IV-12, app A).

o. Eight of nine test soldiers reported that their usual method of using the night vision device was to keep one eye closed while observing. One test soldier reported keeping both eyes open while scanning, and then closing one eye when something was detected. Using the preceding methods, seven test soldiers preferred the test item for target identification and nine test soldiers preferred to use the test item for target detection. Eight test soldiers preferred to use the test item for target recognition and for use under starlight and moonlight conditions at all ranges from 25 to 600 meters. Eight test soldiers reported that they felt they could best estimate the range of targets with the test item (questions 20-22, pages A-IV-12 and A-IV-13, app A).

p. Four test soldiers stated that the test item was easiest to learn to operate properly. One test soldier stated that the control item was easiest to learn to operate properly. Four test soldiers stated that both night vision scopes were equally easy to learn to operate properly (question 23, page A-IV-13, app A).

q. Although all nine test soldiers considered the test item a valuable night vision aid and preferred to use it rather than the control item, two test soldiers reported that it did not function well in woods, and one reported that it was inadequate in fog (questions 24-26, page A-IV-13, app A).

r. Two test soldiers suggested improvement of test item reticles and tube brightness control, and one test soldier recommended addition of a range estimation scale to the control item reticle (question 27, page A-IV-14, app A).

2.11.4.5 A simulated combat observation scenario was conducted at the conclusion of physical testing in which test soldiers simulated a combat outpost observation action using the test item. Table 23 shows the times of reported eye fatigue.

TEST SOLDIER	*Time to First Report of Eye Fatigue	*Rest Time	*Time to Second Report of Eye Fatigue
1	28.0	30	34.0
2	35.0	30	31.0
3	23.8	30	36.5
4	34.0	30	36.0
Standard Deviation	5.27	--	2.50
Mean	30.20	--	34.38

*Time in minutes

Table 23. Times to Reported Eye Fatigue

All test soldiers were able to continue viewing without pause after reporting symptoms of eye fatigue. The symptoms reported by the test soldiers were transient and were eliminated by rest.

2.11.4.6 Observations by test supervisory personnel included the following:

a. The test sight was compatible with use by lefthanded test soldiers.

b. Test soldiers who wore glasses were able to use the test item while wearing glasses. However, any grease or dirt on the eye cup spread on the glasses lens, and the pressure of glasses frames on the eye socket and eyebrow was uncomfortable. Hence, the usual means was to remove the eye glasses and adjust the diopter ring to compensate for the visual deficiency.

c. The test sight/weapon combination was compatible with the soldier and his other equipment, except when carried in the fabric case by the strap only. The strap is too short.

d. The size, weight, and balance of the test item did not create an unusual degree of fatigue or operator performance decrement.

e. Four test soldiers stated a lack of eye and eyebrow recoil protection afforded by the test item rubber eye shield when the scope was used with the M79 and M203 grenade launcher, after continuous firing of 60 rounds of 40-mm ammunition.

f. All test soldiers stated that the mounting bracket for the test item on the M60 was extremely difficult to attach to the weapon. The primary difficulty was with the removal and replacement of the feed tray pin. Test soldiers attempted to avoid mounting the test item on the M60 whenever possible. Test soldier suggestions for improvement of the test item and M60 system includes the comment that a more stable means of mounting be devised that does not require removal and reinsertion of a feed tray cover pin.

g. Test soldiers experienced no difficult performing mounting, boresighting, zeroing, adjusting to range, and remounting of the test item with the M72A2, M16A1, M14, M67, M79, and M203. They were confident of the adequacy of those procedures.

h. Test soldiers had no difficulty in adjusting the range scale on the M79 and M203 mounting brackets.

i. The use of the screwdriver in the dark was difficult and relatively time consuming when attaching the test sight mounting bracket to the M79 grenade launcher.

j. Mounting bracket screws on all brackets lacked a capture device, presenting the possibility of inadvertent loss. Losses of attachment screw and thumbscrew were observed during testing (see paragraph 2.6.4.2).

2.11.5 Analysis

2.11.5.1 Nine of the ten test soldiers who participated in the tactical observation portion of this test (the same nine who participated in the Accuracy subtest) preferred to use the test item rather than the control item.

2.11.5.2 The arrangement, size, and shape of the operator controls permitted tactile identification and adjustment in darkness. The criterion in paragraph 2.11.2.1 is met.

2.11.5.3 The weight and balance of the test item was such that it minimized operator fatigue. The criterion in paragraph 2.11.2.2 is met.

2.11.5.4 The criterion in paragraph 2.11.2.3 is met. The clips supplied with the fabric case were adequate for attachment of the case to web gear. The straps on the fabric carrying case are adequate when used to tie the case to other equipment, but are difficult for the test soldiers to use as a sling. The straps are too short for comfortable sling-carry because they cannot be positioned diagonally across the body. It is suggested that the carrying straps be lengthened to permit a more comfortable diagonal carry.

2.11.5.5 The criterion in paragraph 2.11.2.4 is met for the test item used by itself or with combinations of brackets and weapons, except the M60.

a. Test soldiers could satisfactorily place into operation, adjust, and use the test item while wearing temperate climate cold weather gloves and while wearing arctic gauntlet mittens.

b. The criterion in paragraph 2.11.2.4 is met in relation to all mounting brackets except the M60 mounting bracket. The M60 mounting bracket was difficult to mount while wearing gloves and extremely difficult while wearing arctic mittens, due to difficulty in removing and replacing the feed tray cover pin. This is classified as a shortcoming. It is suggested that the feed tray cover pin be lengthened and the bevel on the end of the feed tray cover pin be lengthened if the present mount bracket configuration is retained. This modification could facilitate insertion of the pin through the spring and feed tray guides.

2.11.5.6 During the eye fatigue exercise, the test soldiers reported experiencing symptoms of eye fatigue (eyes hurt or watered, vision fuzzy) after approximately 30 minutes of continuous observation with the test sight. Following a 30-minute rest period, the test soldiers were able to make continuous observations for approximately 34 minutes. The eye fatigue symptoms reported by the test soldiers were transient and were eliminated by a 30-minute rest period.

2.12 VALUE ANALYSIS

2.12.1 Objective

To determine whether the test sight contains any unnecessary or costly features which could be eliminated without sacrificing essential quality, reliability, maintainability, performance, or mission accomplishment.

2.12.2 Criterion

None

2.12.3 Method

During all test activities, special attention was given to detecting and recommending the elimination of nonessential or nice-to-have features, simplification of maintenance, reduction of weight and overall dimensions without sacrificing essential quality, safety, reliability, maintainability, performance, or mission accomplishment.

2.12.4 Results

No unnecessary or costly features were noted.

2.12.5 Analysis

None

SECTION 3. APPENDICES

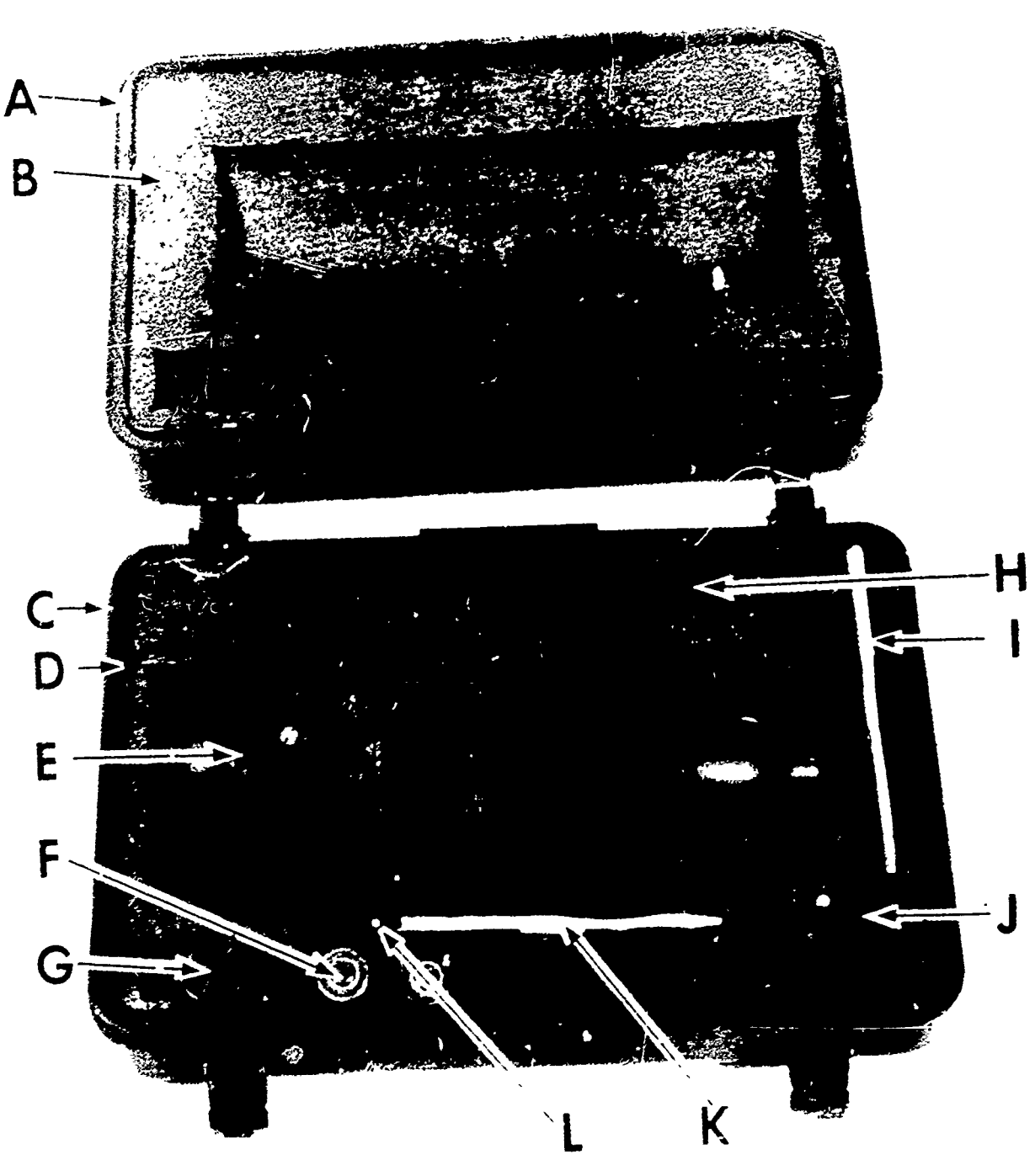
APPENDIX A

PART I - FIGURES

PART II - FIRING DATA ANALYSIS

PART III - TABLES

PART IV - QUESTIONNAIRES



G - M16A1 adaptor bracket

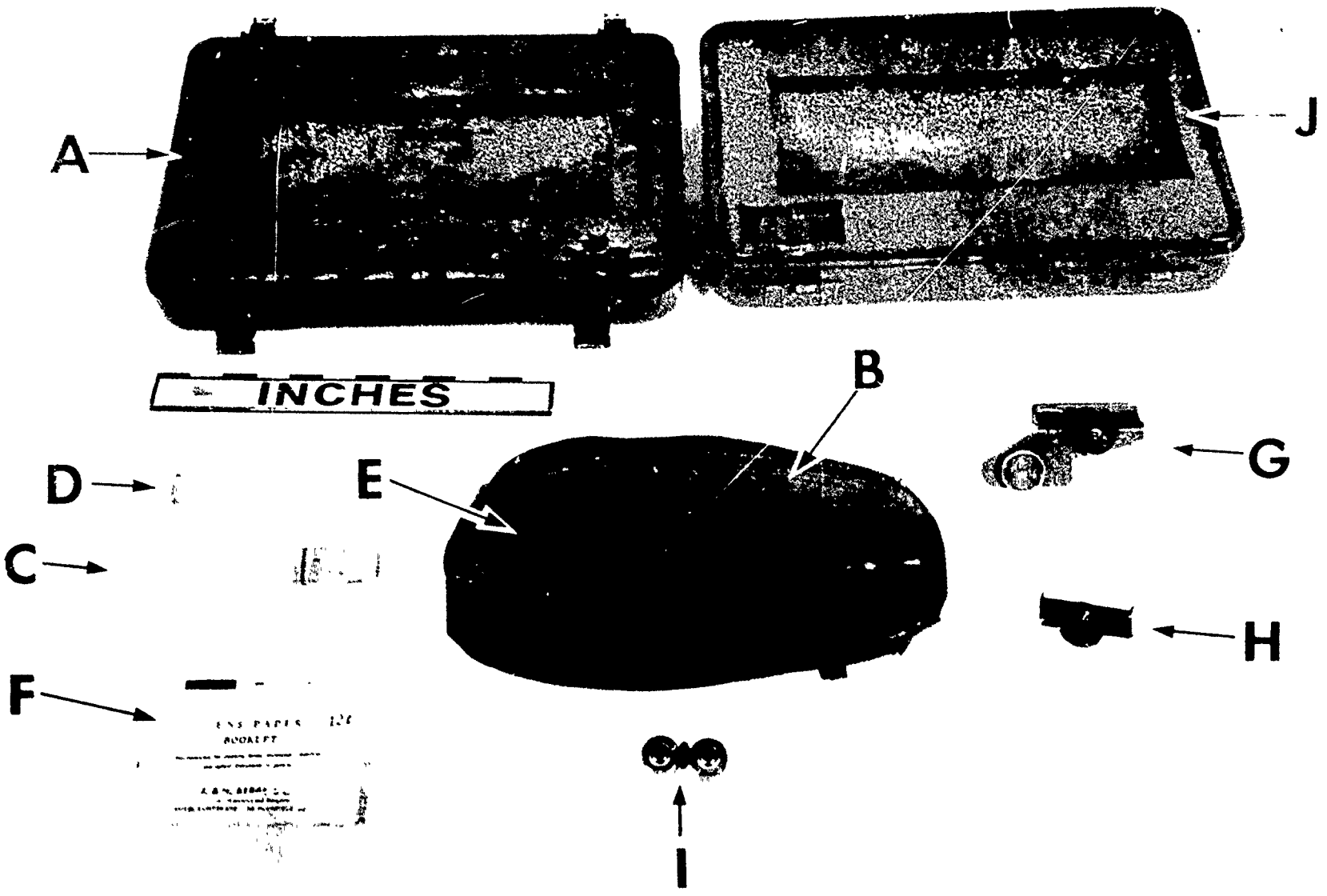


Figure A-2. Night Vision Sight, Individual Served Weapons, AN/PVS-4, and Accessories

LEGEND

A - Upper lid, shipping container
B - Carrying case
C - Lens brush
D - Socket head key
E - Night Vision Sight, AN/PVS-4
F - Lens tissue
G - M14 adaptor bracket
H - M16A1 adapter bracket
I - Batteries
J - Lower lid, shipping container

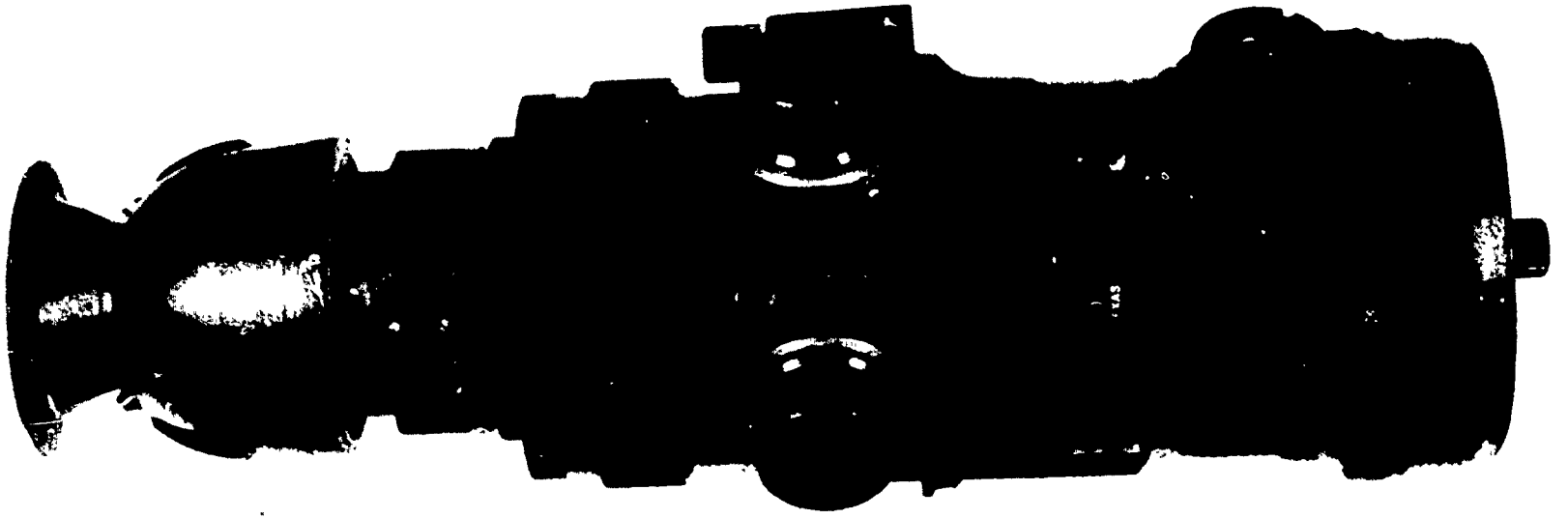


Figure A-3. Night Vision Sight, Individual Served Weapons, AN/PVS-4 (Right View)

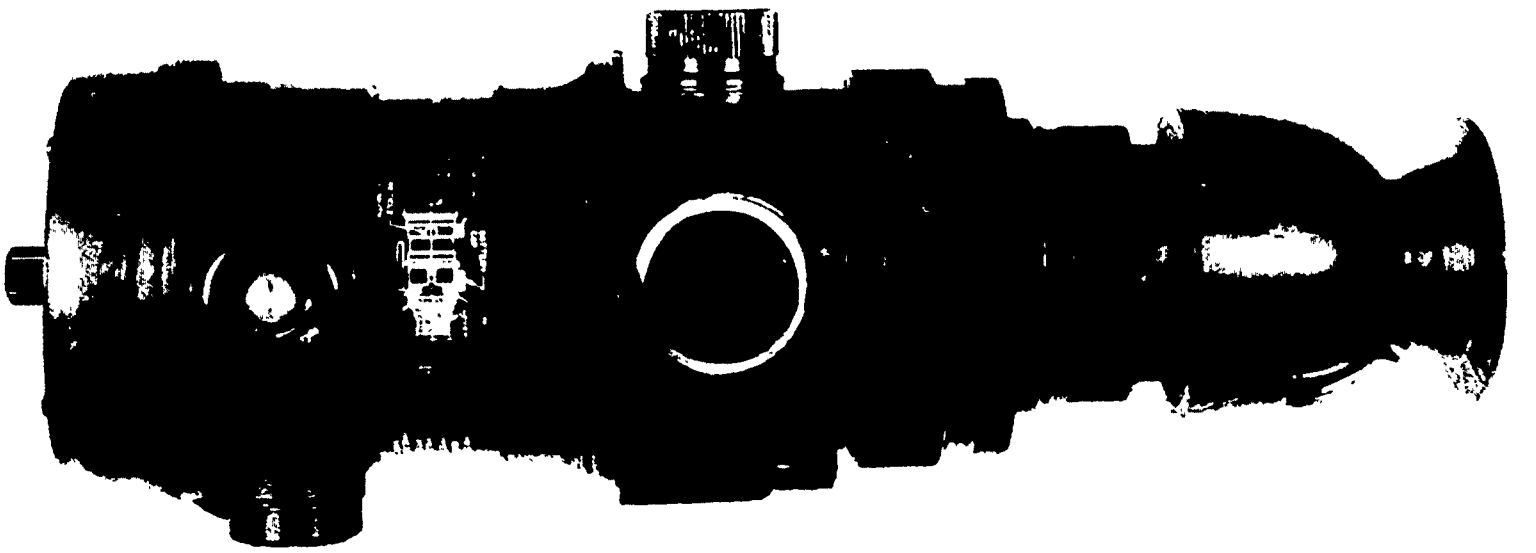


Figure A-4. Night Vision Sight, Individual Served Weapons, AN/PVS-4 (Top View)

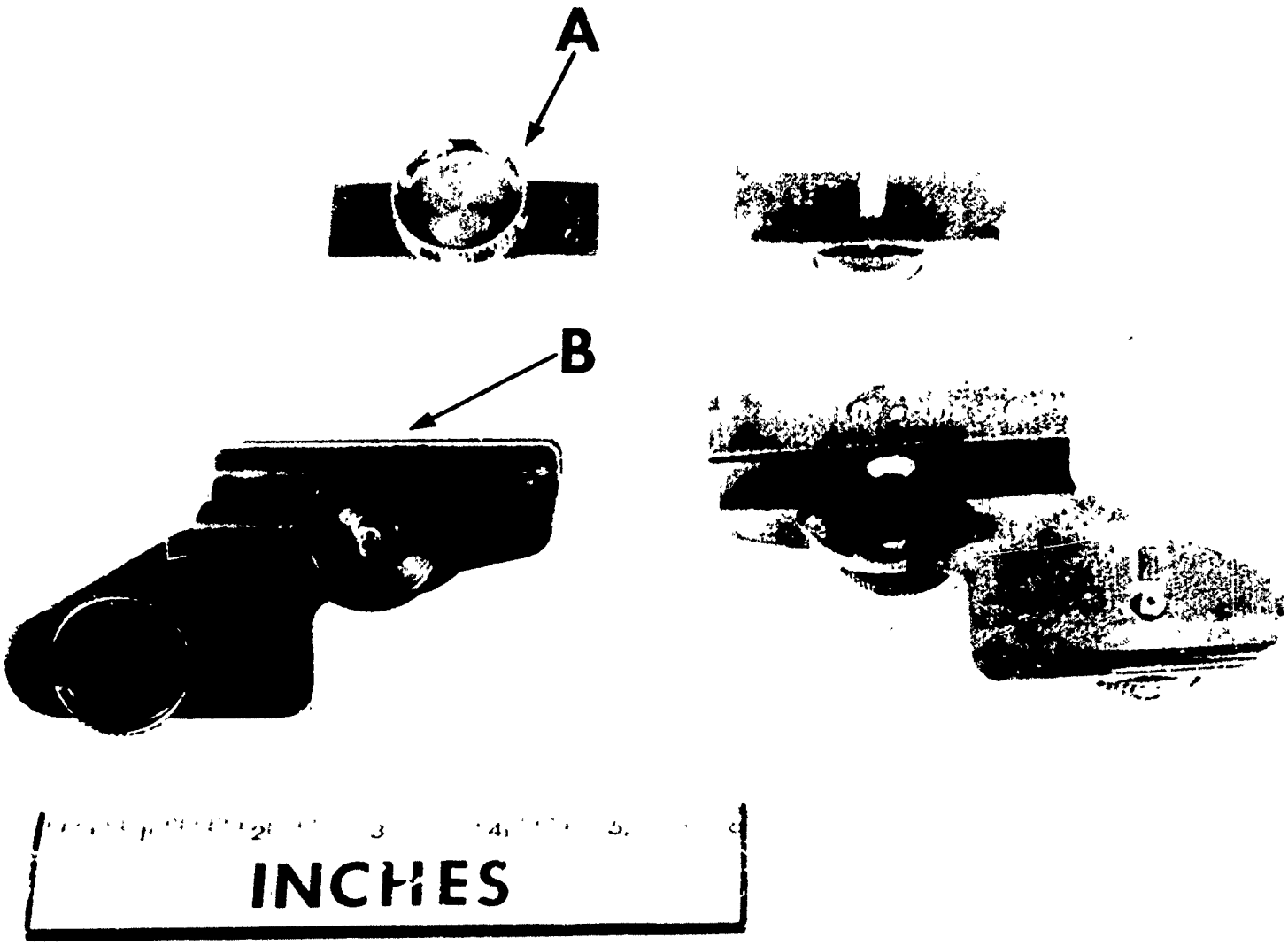


Figure A-5. Mounting Brackets for M14 and M16A1 Rifles

LEGEND
A - M16A1 adaptor bracket
B - M14 adaptor bracket
(Arrows indicate outside view.)

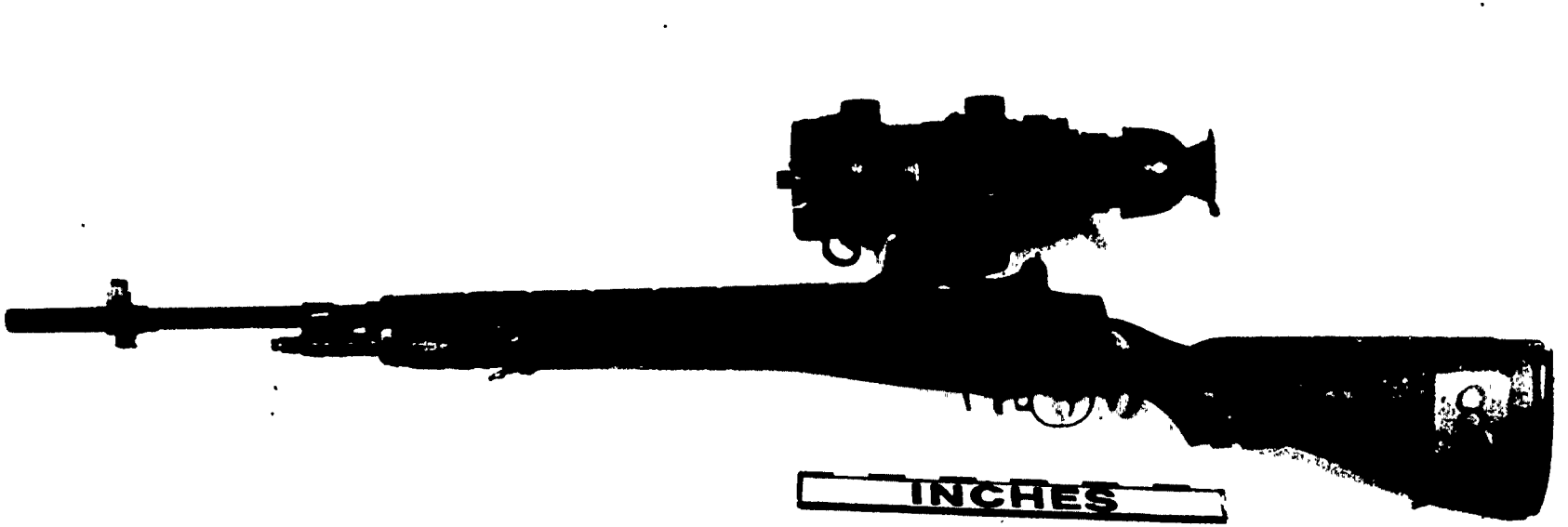


Figure A-6. Night Vision Sight, Individual Served Weapons, AN/PVS-4, Mounted on M14 Rifle

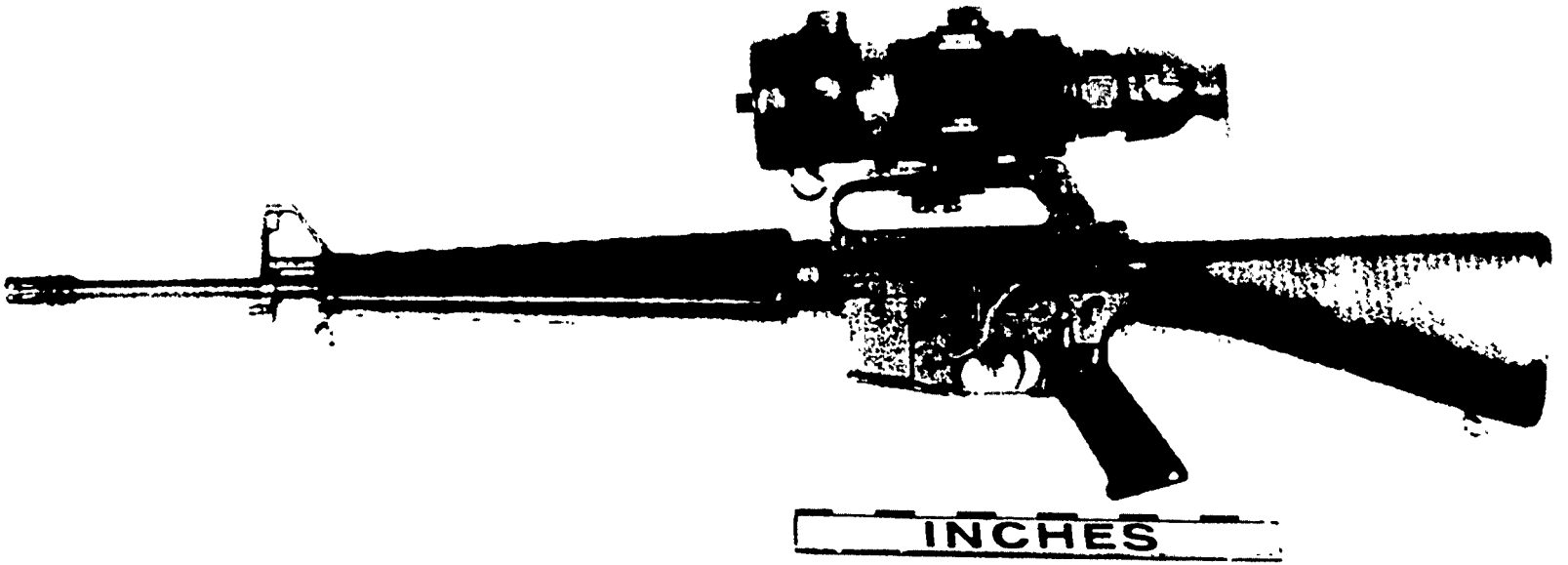


Figure A-7. Night Vision Sight, Individual Served Weapons, AN/PVS-4, Mounted on M16A1 Rifle

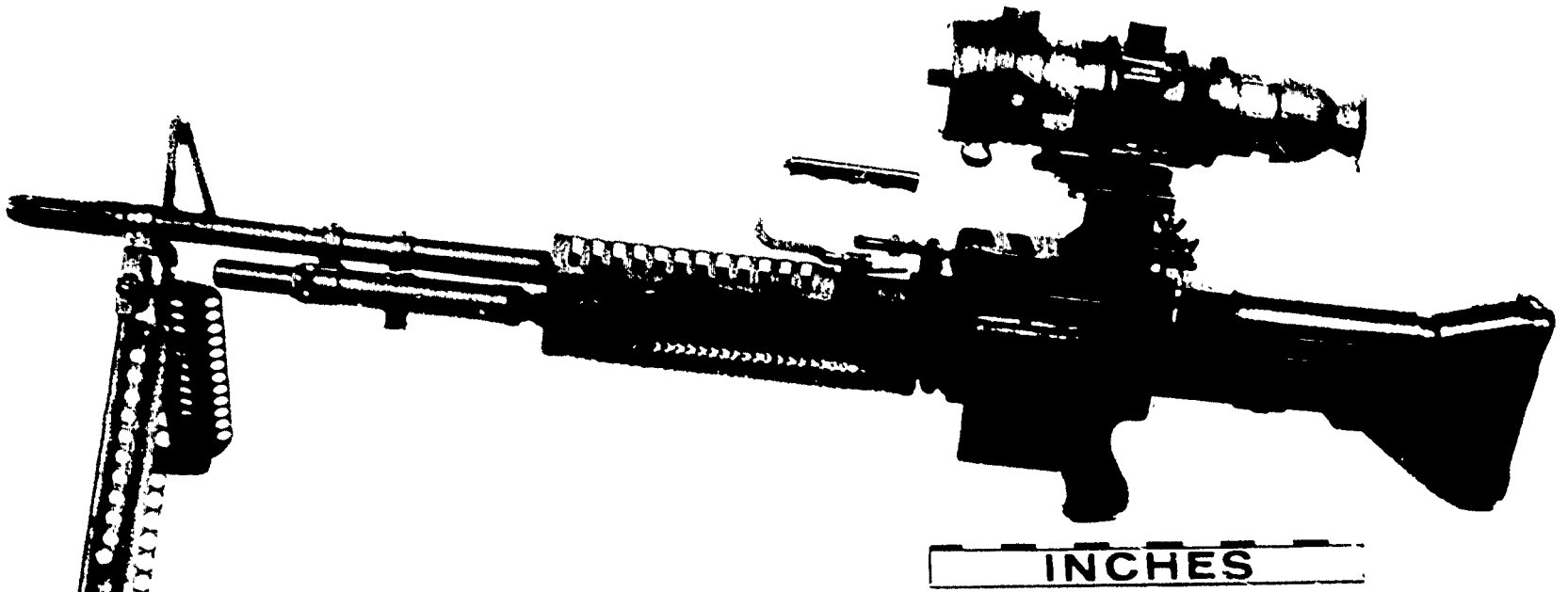


Figure A-8. Night Vision Sight, Individual Served Weapons, AN/PVS-4, Mounted on M60 Machine Gun

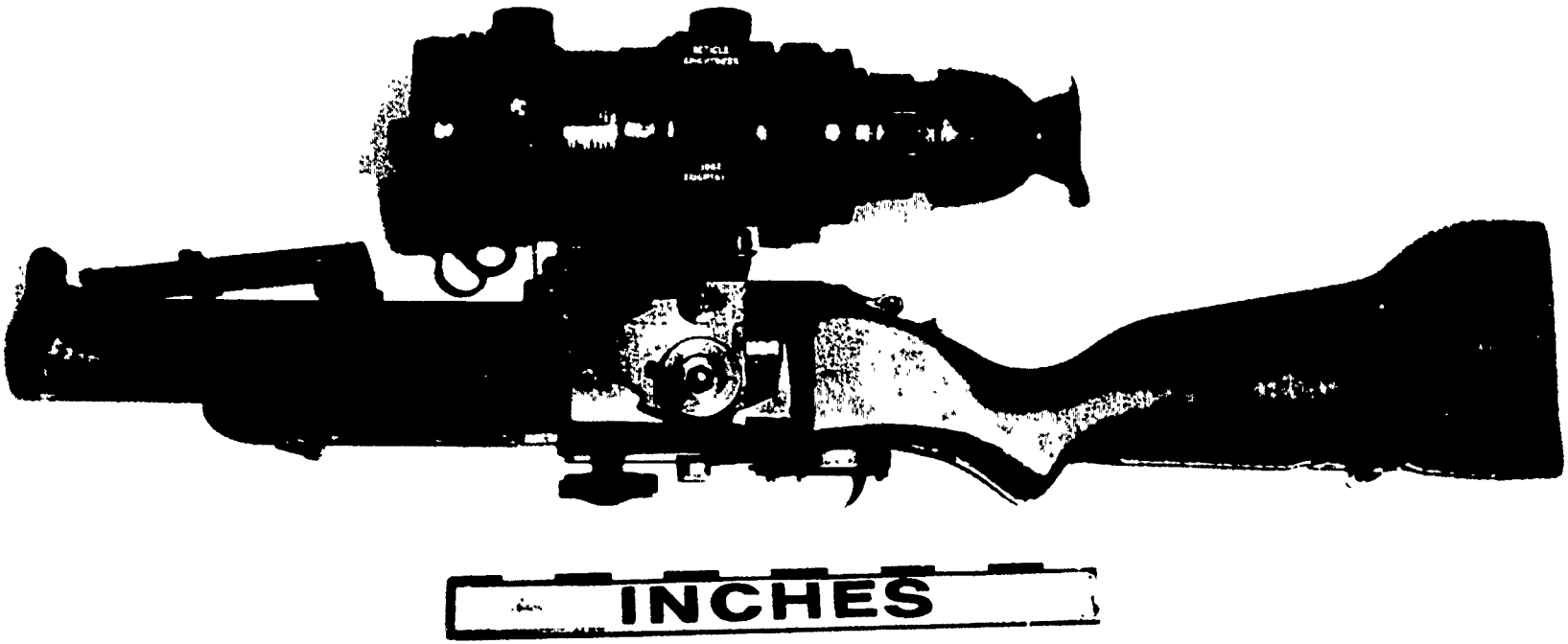


Figure A-9 . Night Vision Sight, Individual Served Weapons, AN/PVS-4, Mounted on M79 Grenade Launcher

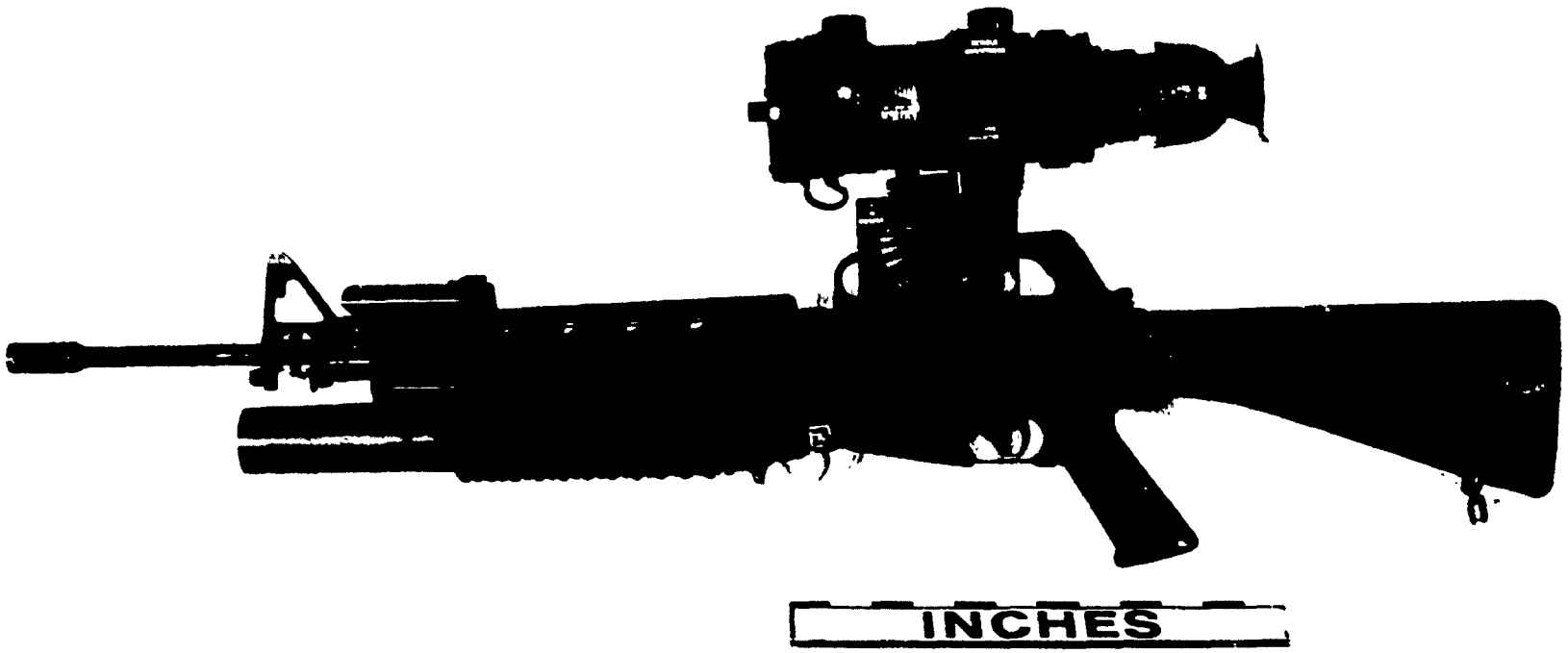


Figure A-10. Night Vision Sight, Individual Served Weapons, AN/PVS-4, Mounted on M16A1/M203 Grenade Launcher

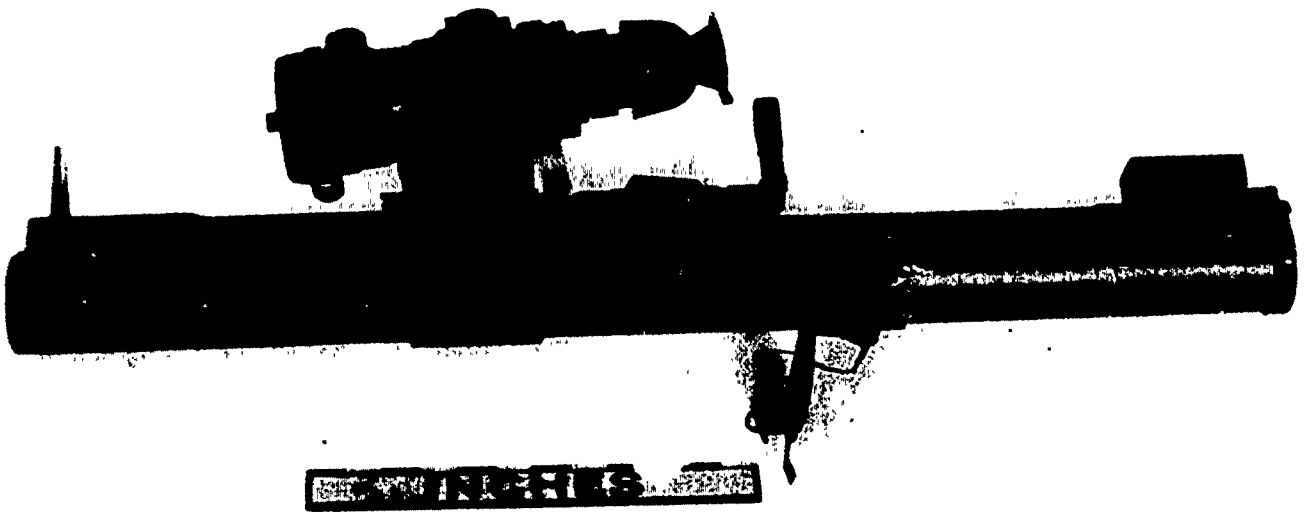


Figure A-11. Night Vision Sight, Individual Served Weapons, AN/PVS-4, Mounted on M72A2 LAW

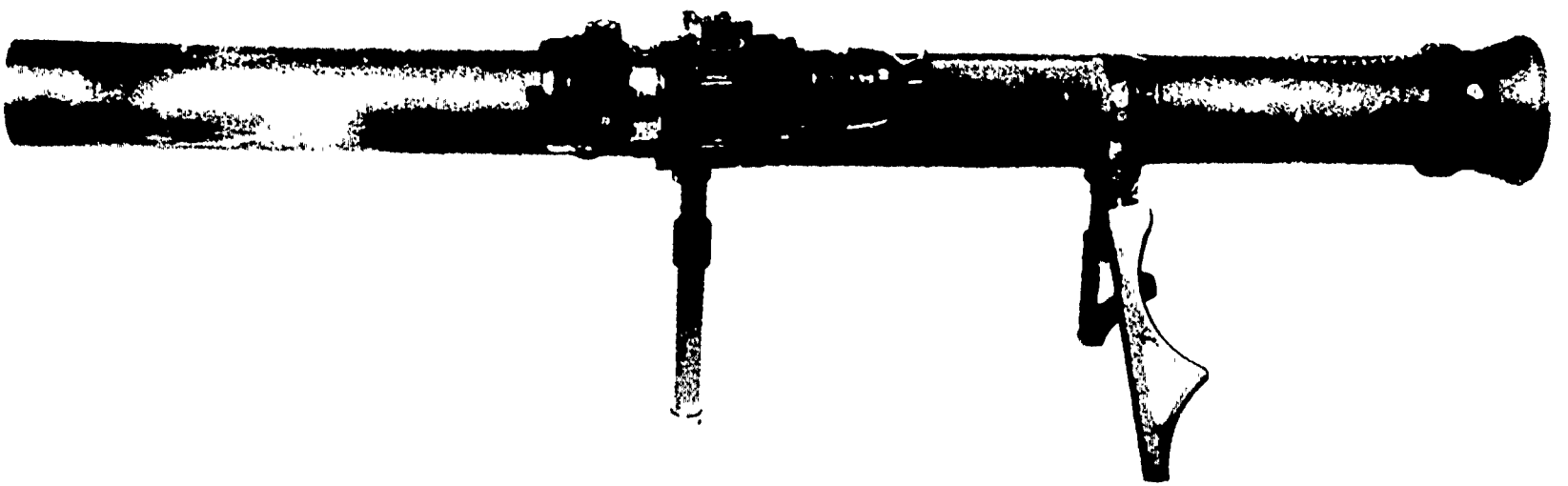


Figure A-12. Night Vision Sight, Individual Served Weapons, AN/PVS-4, Mounted on M67 Recoilless Rifle

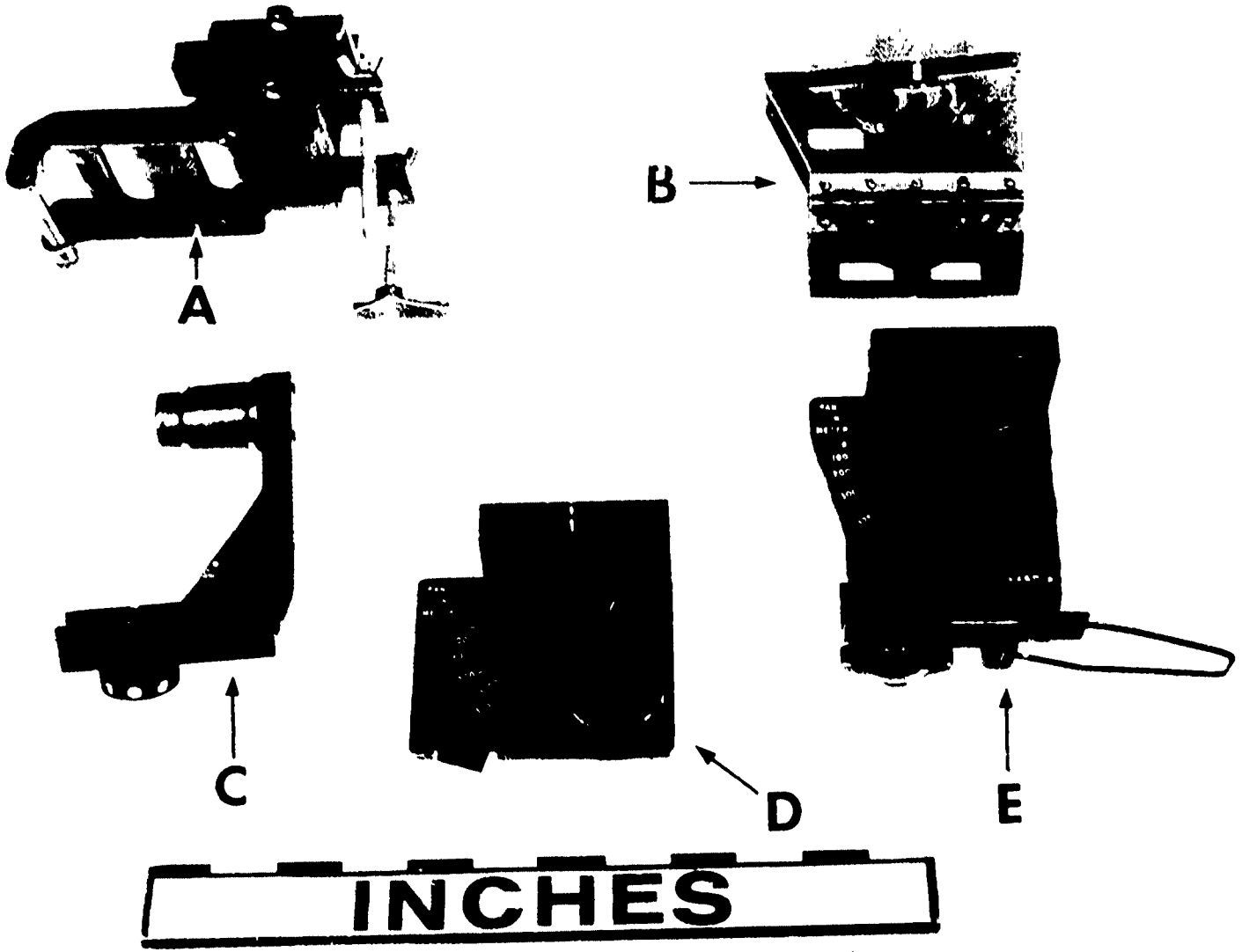


Figure A-13. Individual Weapon Sight Adaptor Brackets

LEGEND

A - M60 machine gun adaptor bracket
B - Light anti-tank weapon, 66-mm, M72A2, adaptor bracket
C - M67 recoilless rifle adaptor bracket
D - M16A1/M203 grenade launcher adaptor bracket
E - M79 grenade launcher adaptor bracket

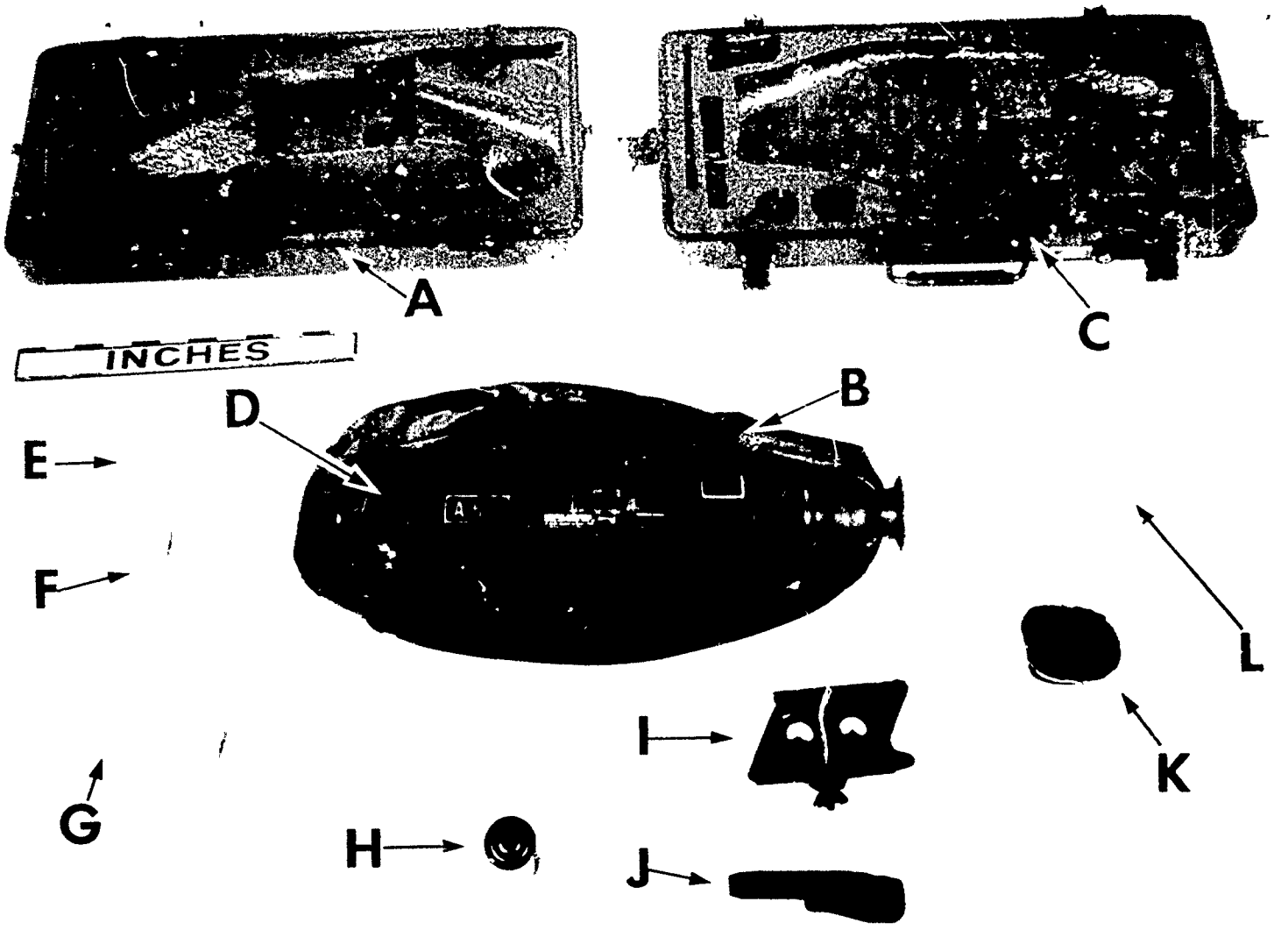


Figure A-14. Night Vision Sight, Individual Served Weapons, AN/PVS-2B, and Accessories

LEGEND

A - Upper lid, shipping container
B - Carrying case
C - Lower lid, shipping container
D - AN/PVS-2B
E - Socket Head Key
F - Brush
G - Lens Paper
H - Batteries, BA, 110/V
I - M14 Mounting Bracket Assembly
J - M16A1 Mounting Bracket Assembly
K - Carrying Strap
L - TM 11-5855-203-13, w/Ch 1, 2, 3

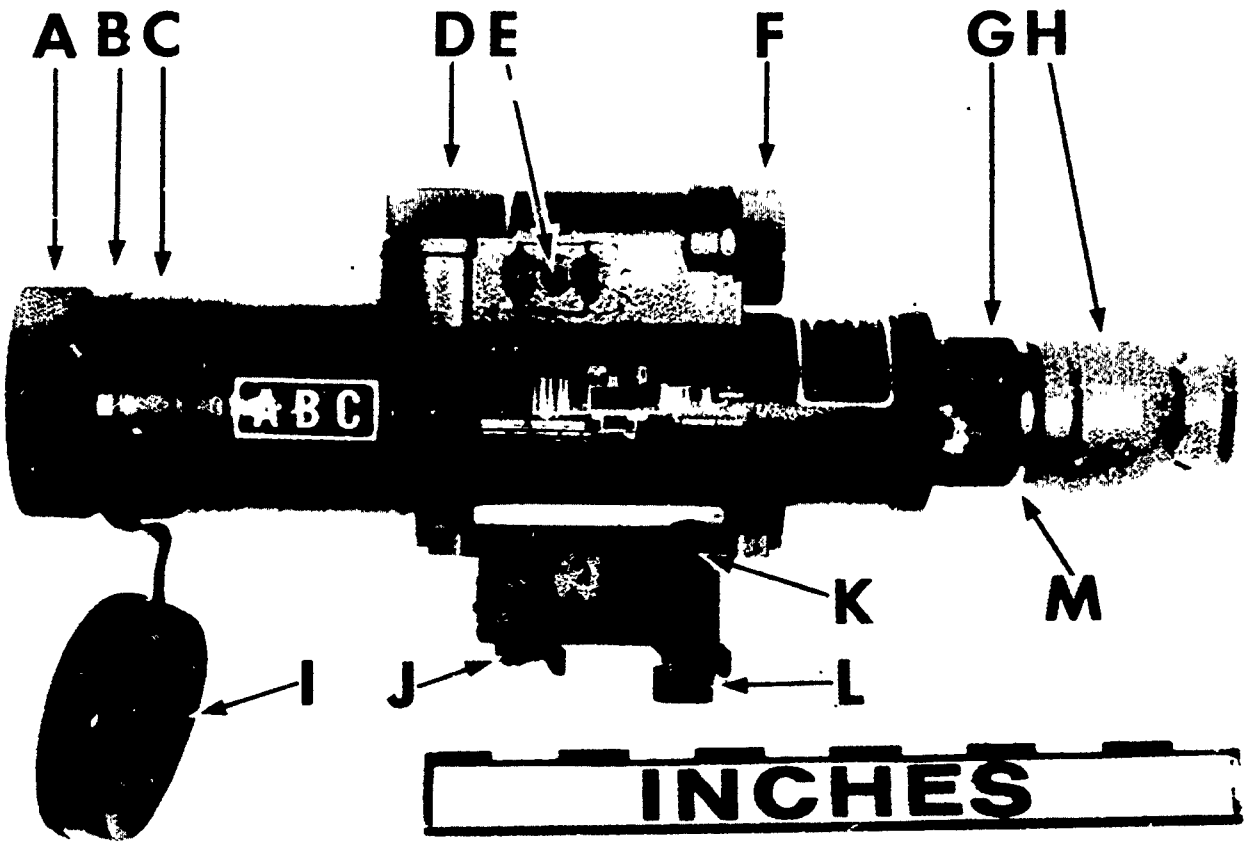


Figure A-15. Night Vision Sight, Individual Served Weapons, AN/PVS-2B (Left View)

LEGEND

A - Range focus ring
B - Objective lens assembly
C - Main housing
D - Oscillator cap
E - Power switch
F - Battery cap
G - Focus ring with Diopter scale
H - Eye shield
I - Lens cap
J - Boresight mount assembly
K - Azimuth adjustment knob
L - Elevation adjustment knob
M - Green knurled adapter ring (safety eye shield)

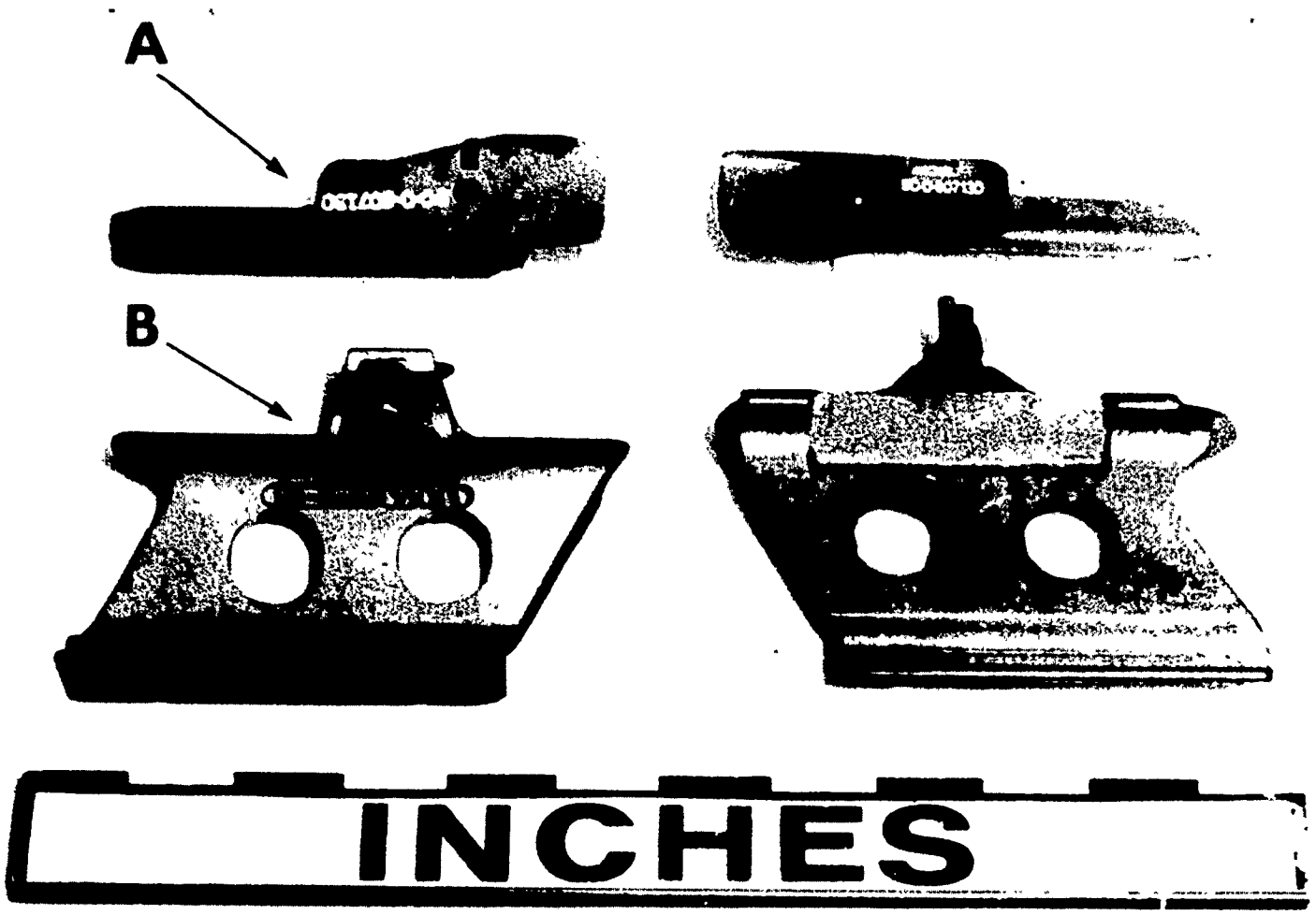


Figure A-16. Night Vision Sight, Individual Served Weapons, AN/PVS-2B, Mounting Bracket Assemblies

LEGEND

A - M14 Mounting Bracket Assembly
B - M16A1 Mounting Bracket Assembly

(Arrow indicates outside view.)

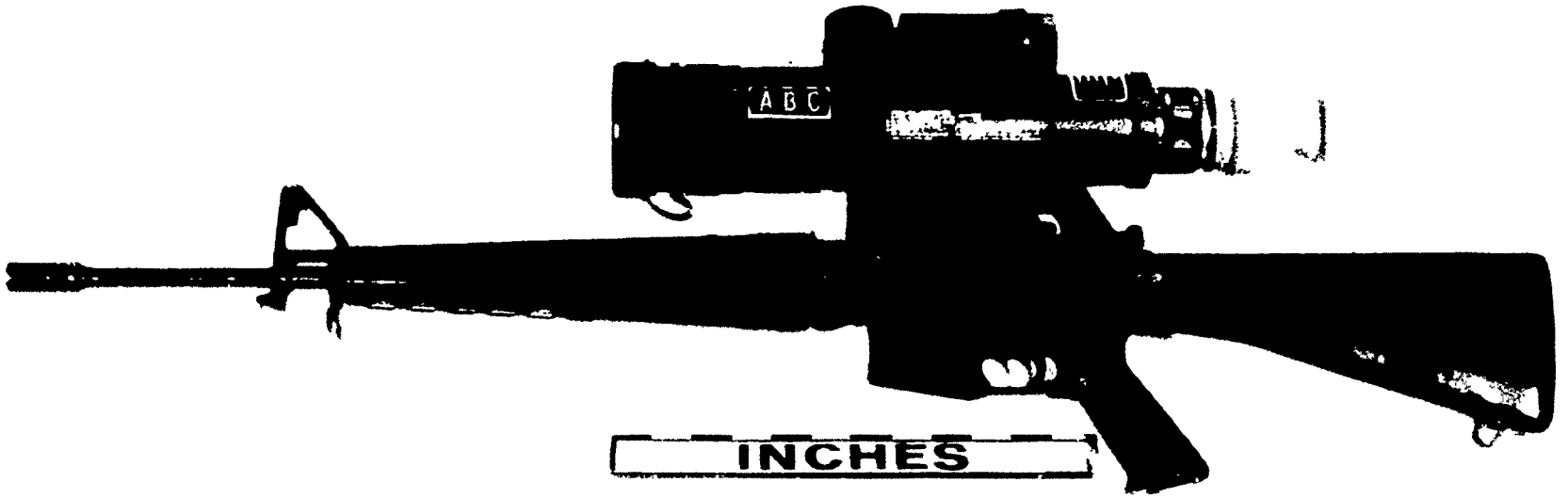


Figure A-17. Night Vision Sight, Individual Served Weapons, AN/PVS-2B, Mounted on M16A1 Rifle (Left View)

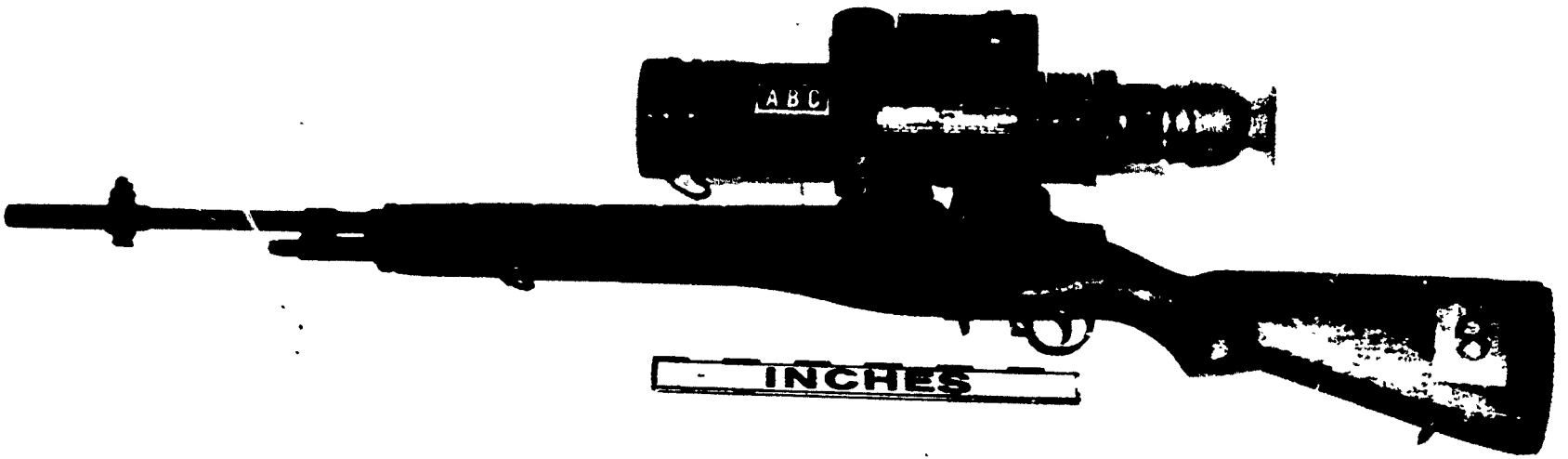


Figure A-18. Night Vision Sight, Individual Served Weapons, AN/PVS-2B, Mounted on M14 Rifle (Left View)

Figure A-19. Subtest No 4, Tactical Observation Test Area I (Open Field)
(Grid Coordinates 9373, Map Sheet No 4048 IV)

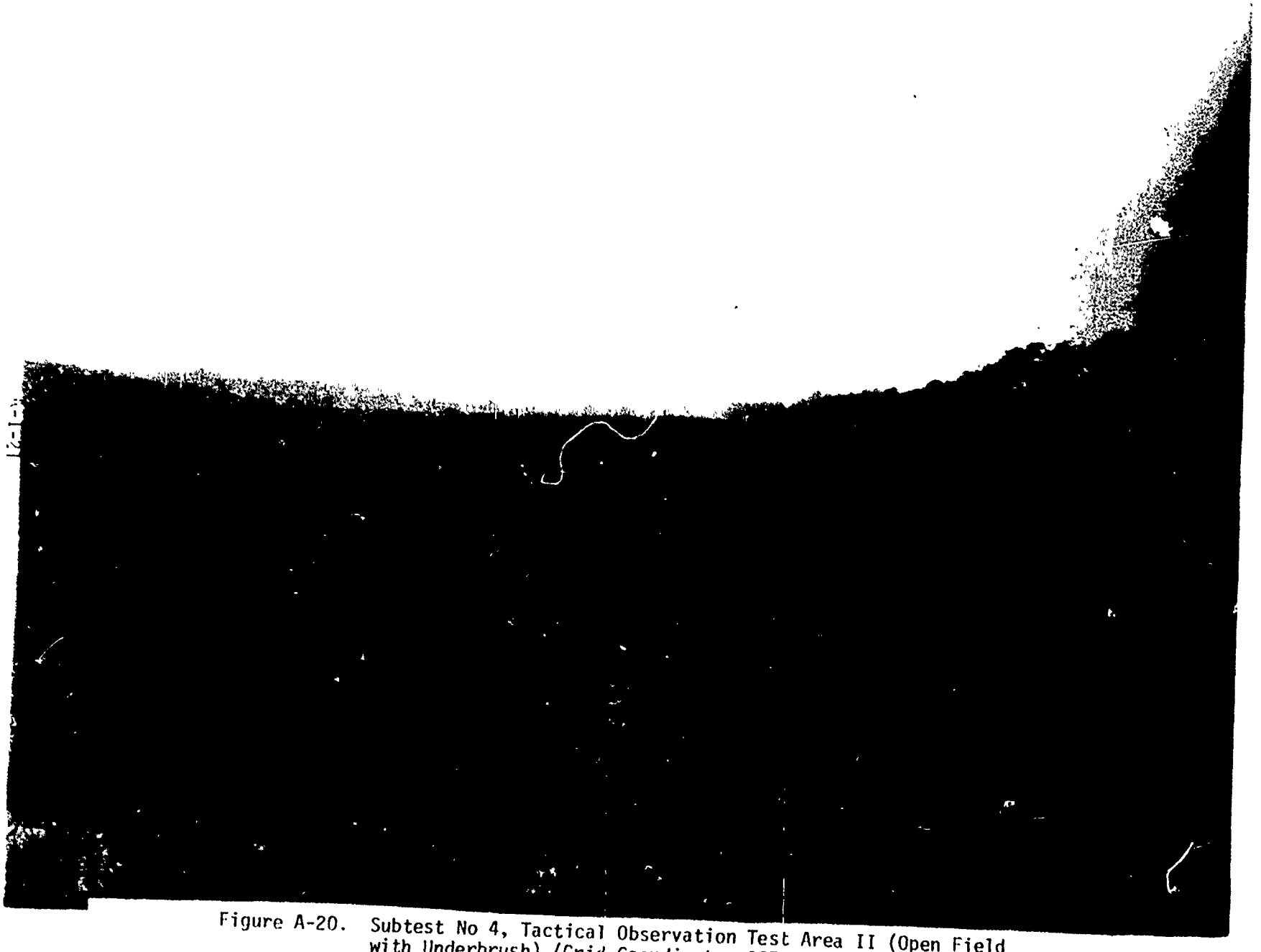


Figure A-20. Subtest No 4, Tactical Observation Test Area II (Open Field with Underbrush) (Grid Coordinates 9274, Map Sheet No 4048 IV)

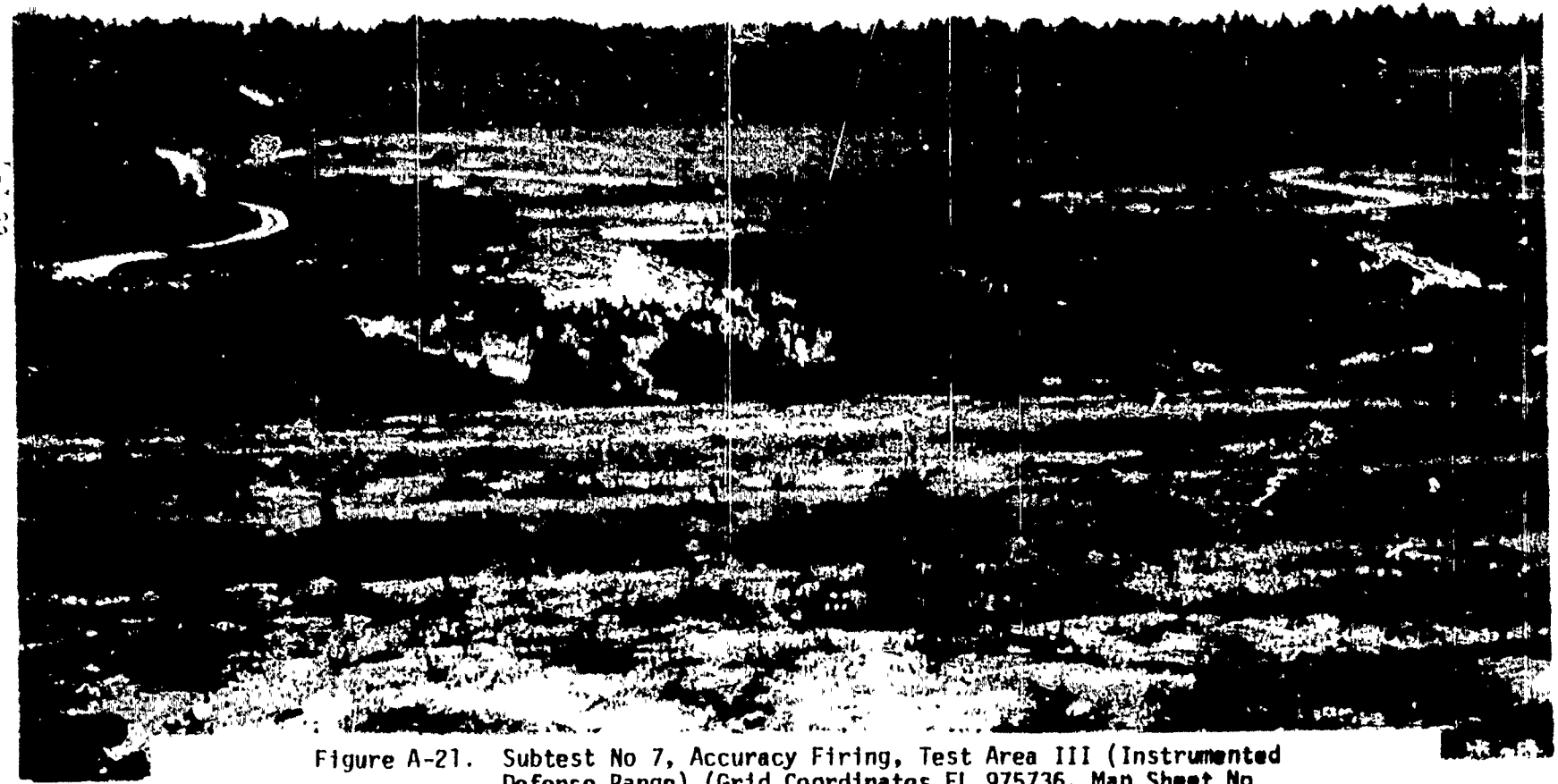


Figure A-21. Subtest No 7, Accuracy Firing, Test Area III (Instrumented Defense Range) (Grid Coordinates FL 975736, Map Sheet No 4048 IV)

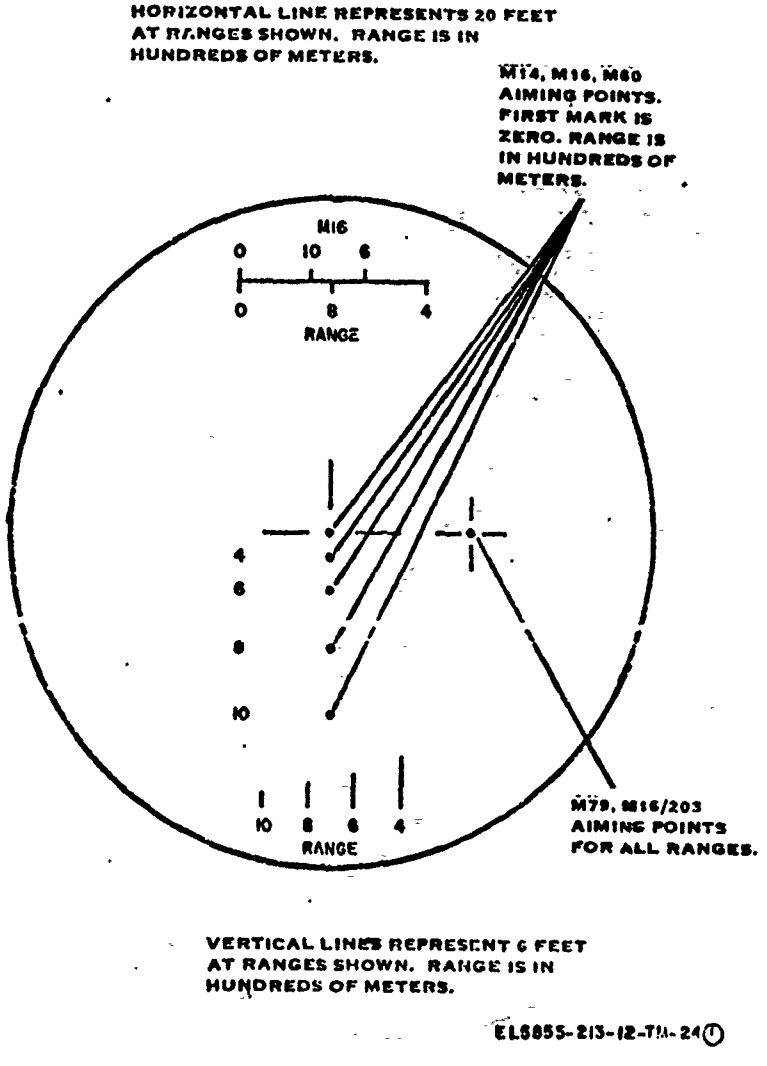


Figure A-22. Reticle Pattern (M14, M16A1, M60, M79, and M203), Night Vision Sight, Individual Served Weapons, AN/PVS-4

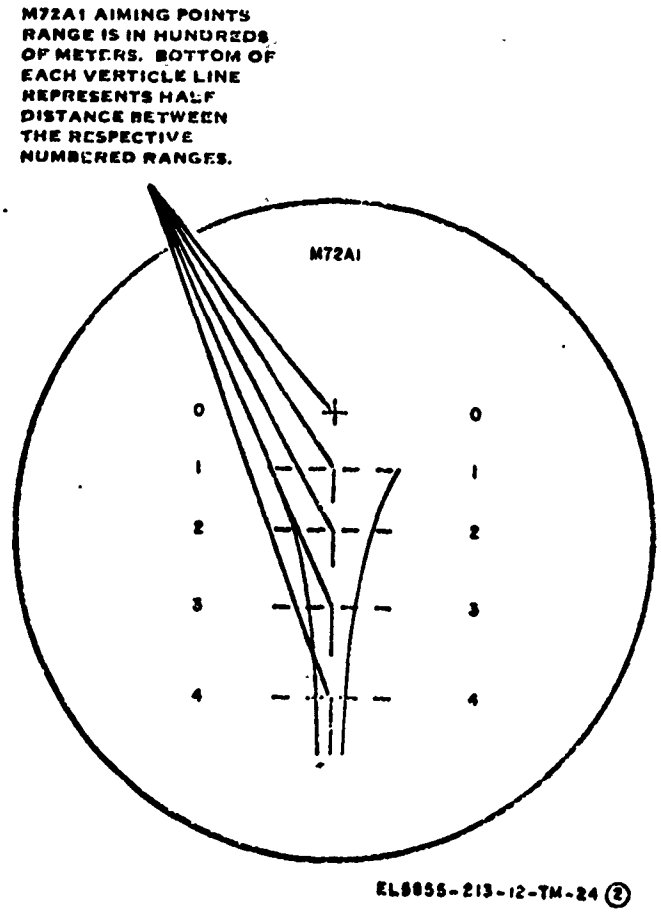


Figure A-23. M72A1/A2 Reticle Pattern
Night Vision Sight, Individual Served Weapon, AN/PVS-4

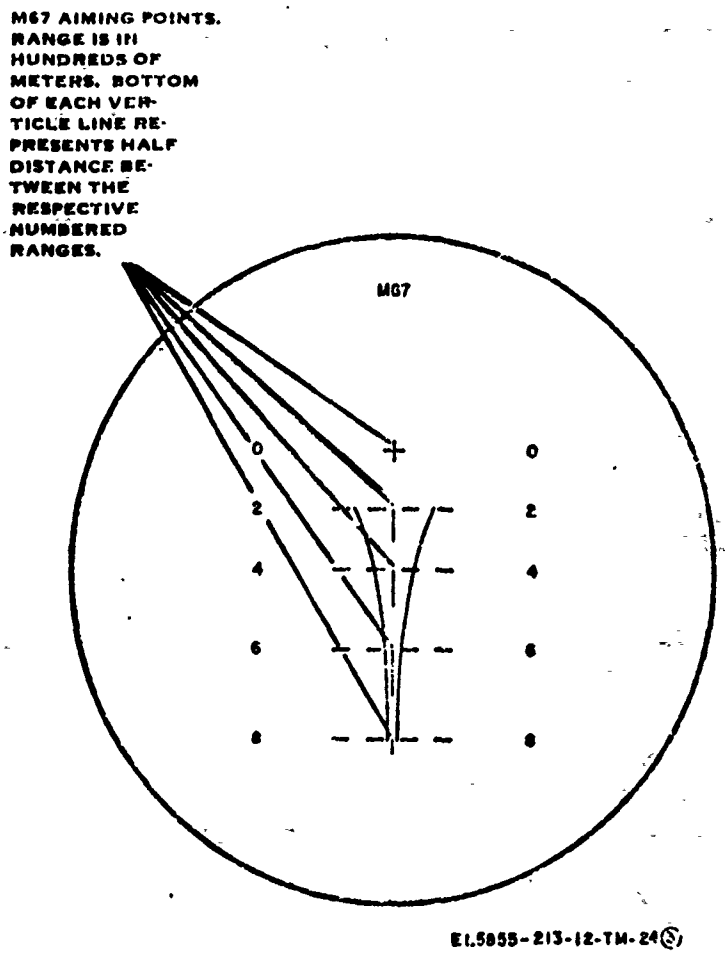
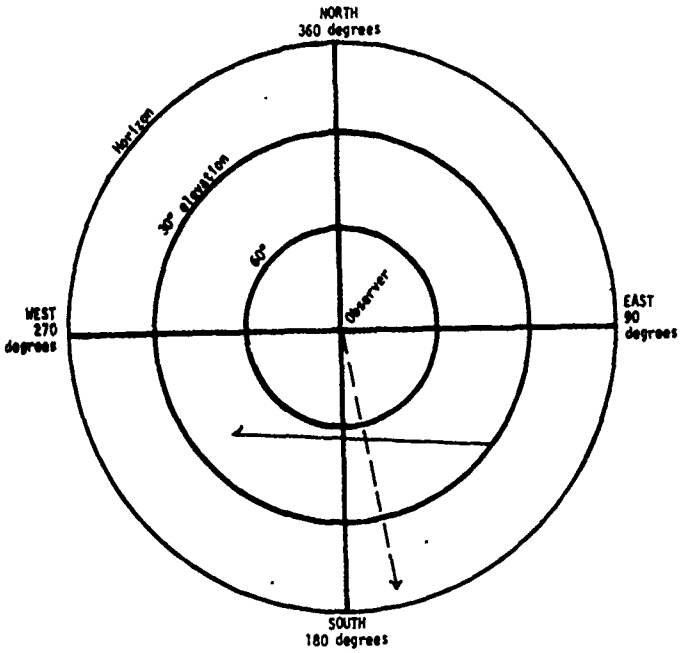
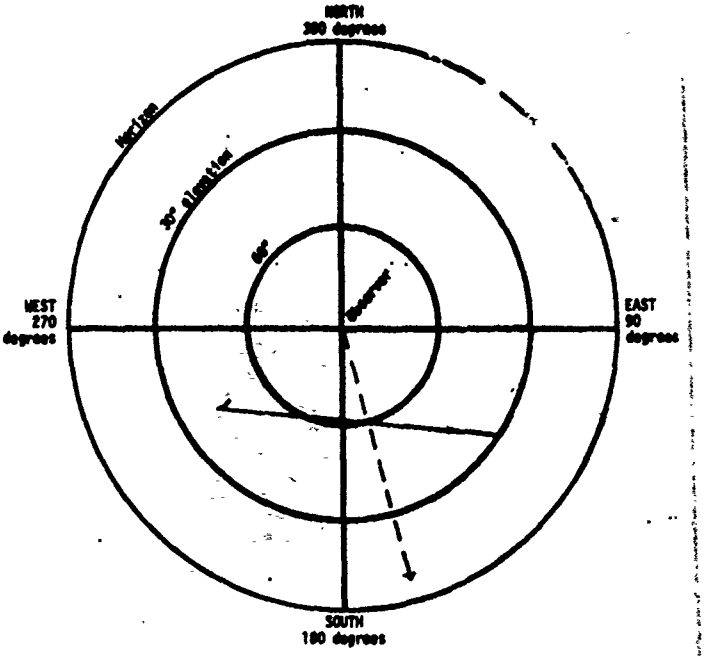


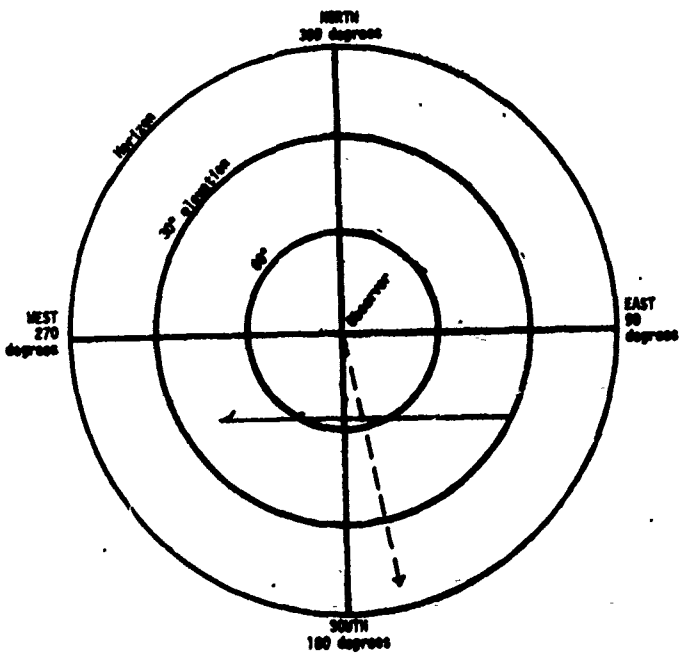
Figure A-24. M67 Reticle Pattern
Night Vision Sight, Individual Served Weapon, AN/PVS-4



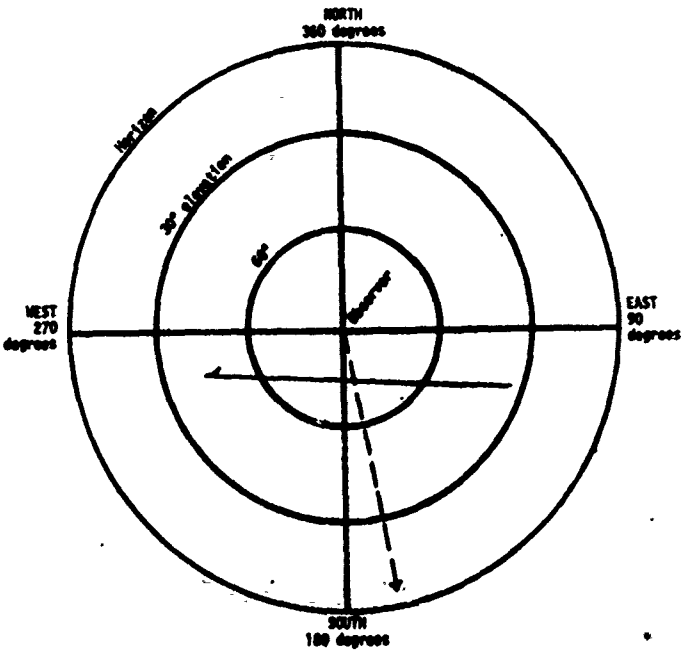
11 Jun 74



12 Jun 74



17 Jun 74

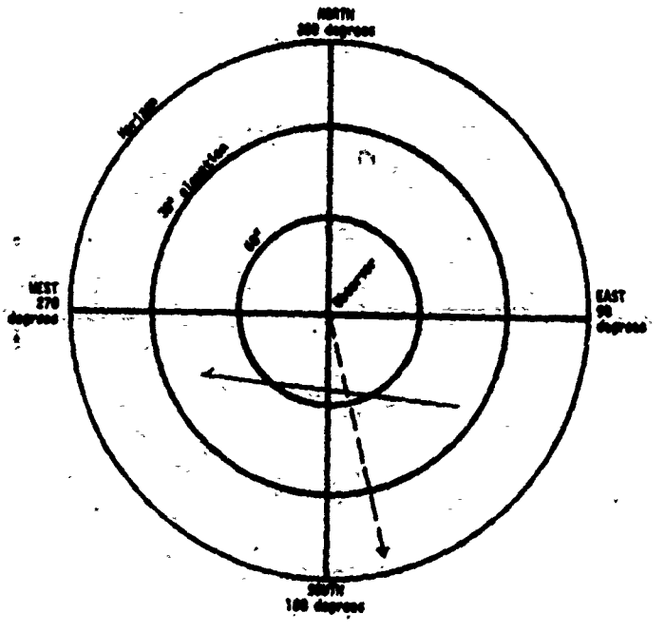


24 Jun 74

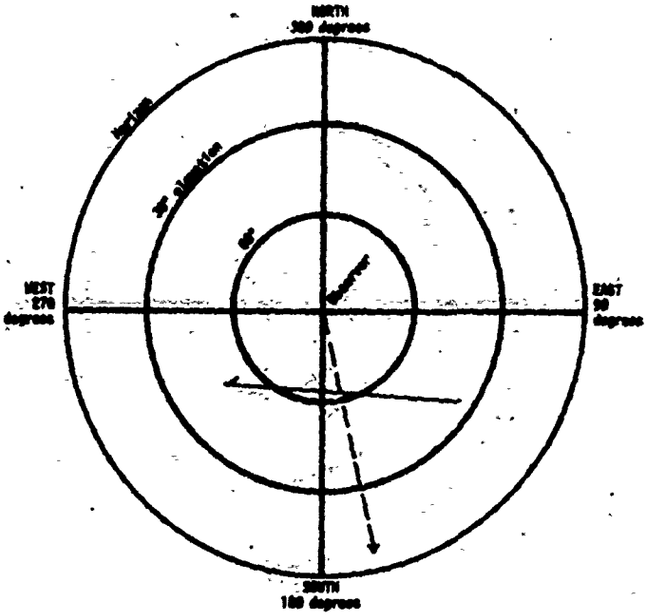
Path of Moon

Direction of Observer

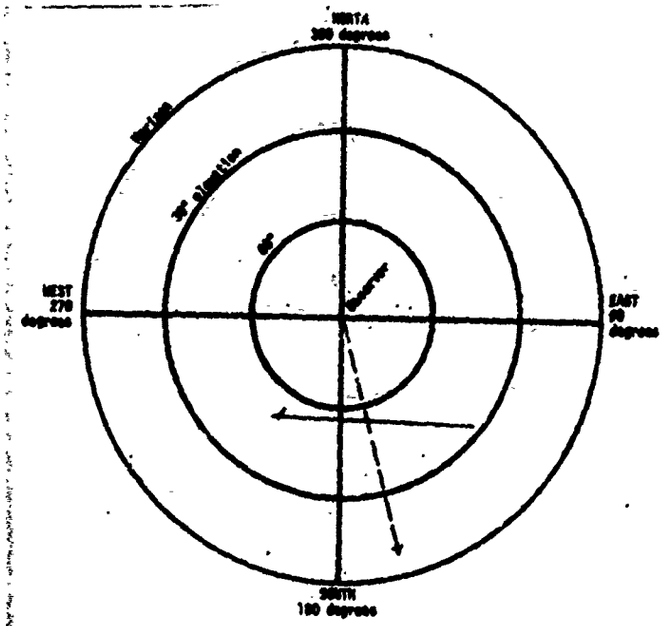
Figure A-25. Moon Data, Tactical Observation, Test Area I



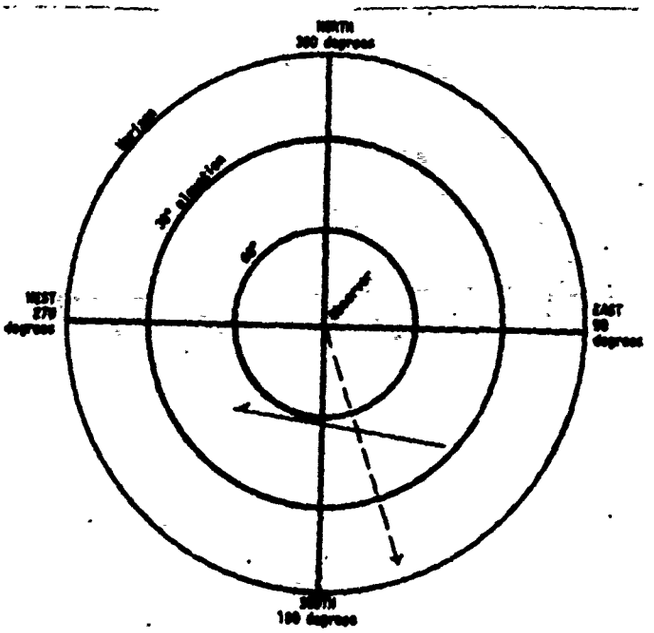
27 Jun 74



1 Jul 74



3 Jul 74

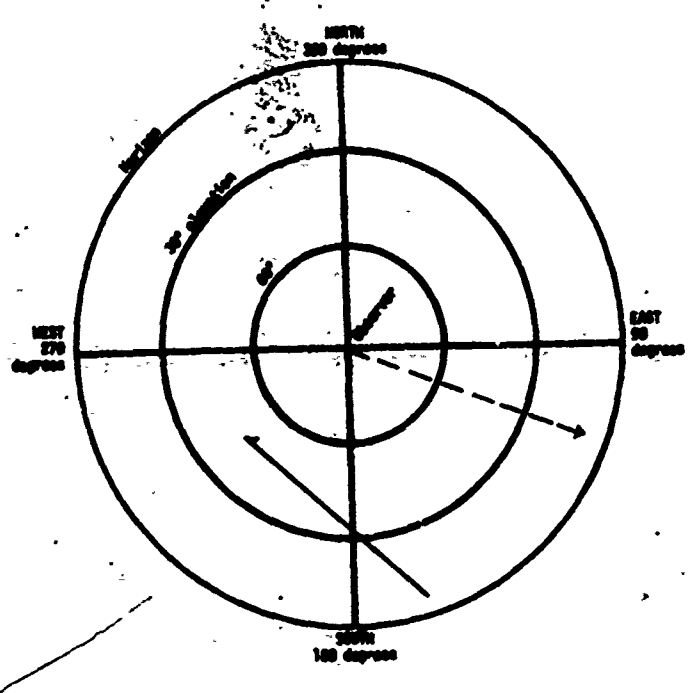


8 Jul 74

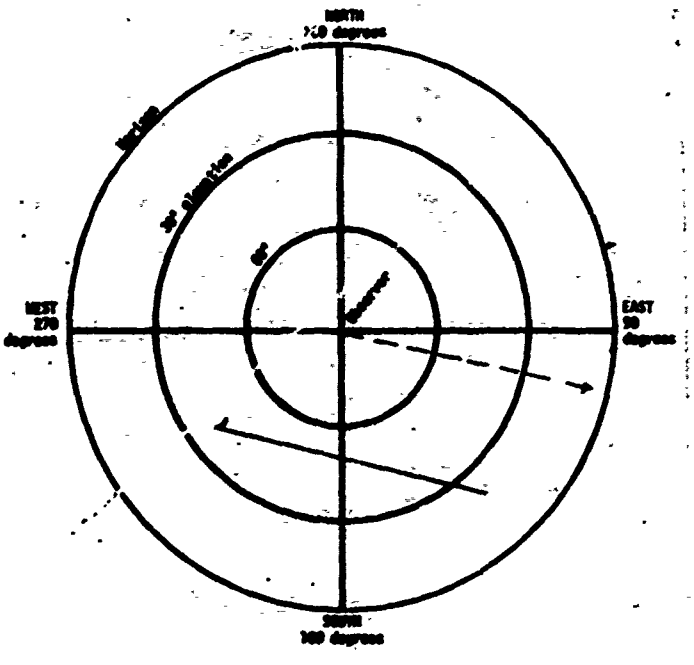
Path of Moon

Direction of Observer

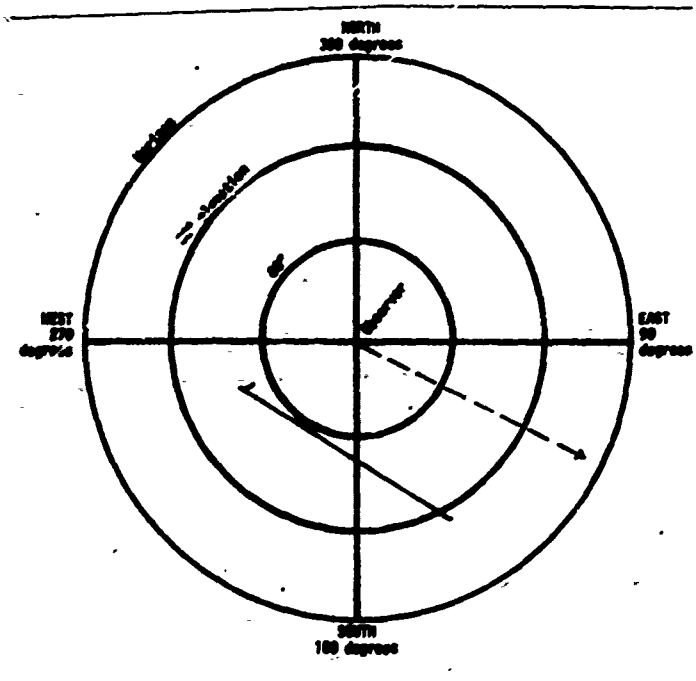
Figure A-26. Moon Data, Tactical Observation, Test Area I



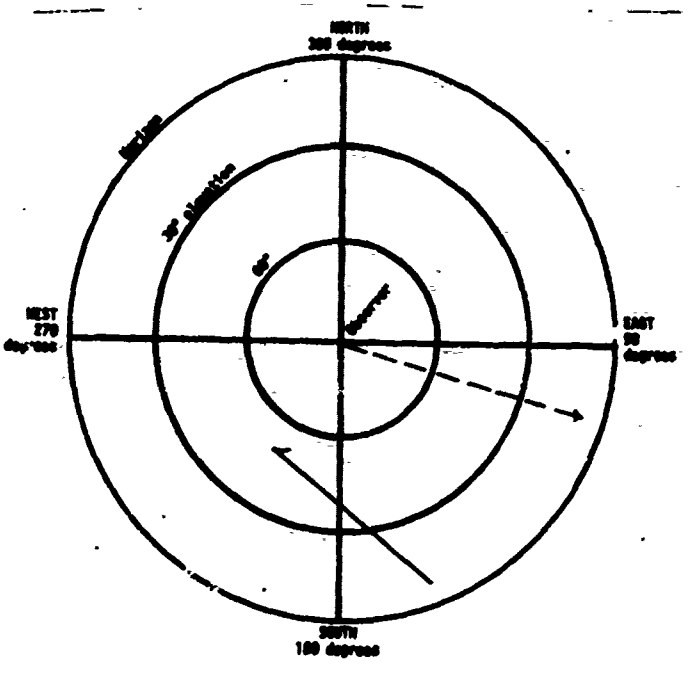
17 Jul 74



18 Jul 74



29 Jul 74

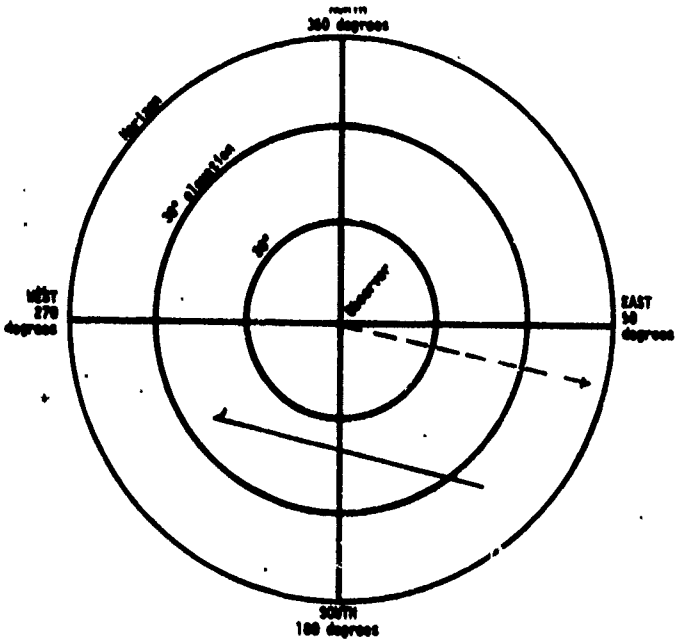


30 Jul 74

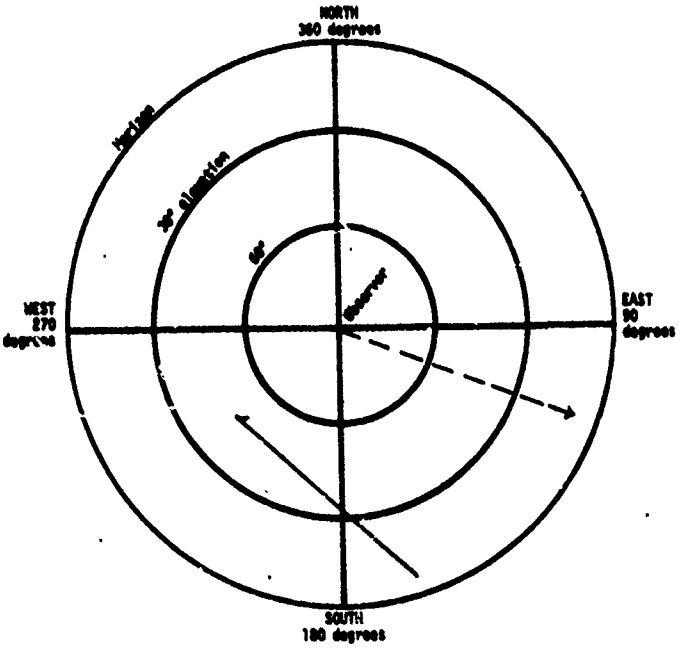
Path of Moon

Direction of Observer

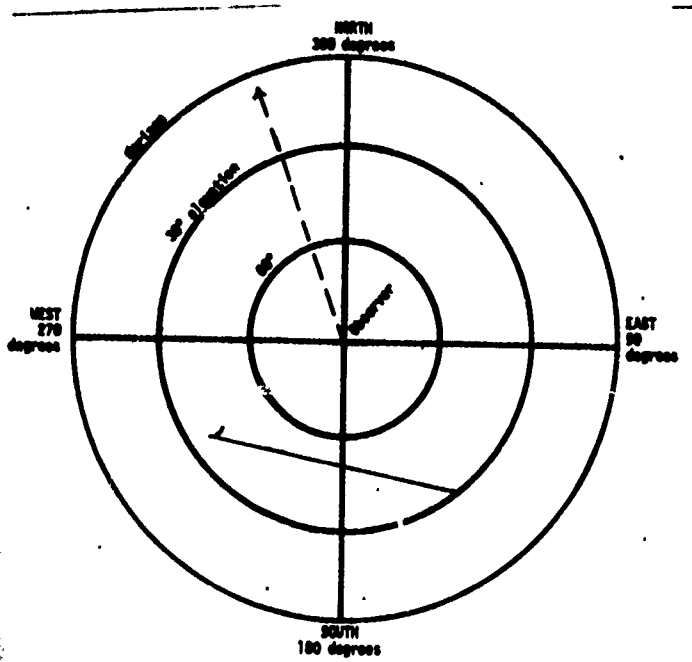
Figure A-27. Moon Data, Tactical Observation, Test Area II



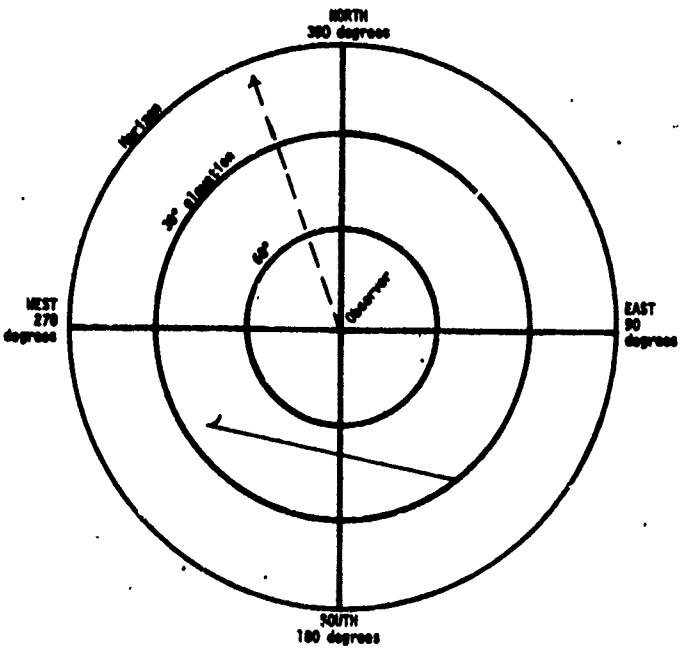
26 Aug 74



27 Aug 74



24 Oct 74



25 Oct 74

Path of Moon

Direction of Observer

Figure A-28. Moon Data, Accuracy Firing, Test Area III

PART II - APPENDIX A

Firing Data Analysis

1. This part presents the analysis of the firing results for Subtest No 7 (Accuracy). The results are shown in Tables 7 through 17 in the subtest. Subsequent paragraphs are keyed by weapon systems.

2. M16A1 Rifle.

a. Defense Scenario (Table 7).

(1) The HP against stationary targets for daylight firing with the standard daylight sights and for moonlight and starlight firing with the test sight were compared using an analysis of variance at the .10 level of significance. Significant differences were isolated using a Scheffe Multiple Range Test. The results of these analyses are shown in Table A-II-1 and indicate that:

(a) The HP with the test sight is significantly lower during starlight (.115) than the HP with standard daylight sights during daylight (.282).

(b) The HP with the test sight during starlight and moonlight firing are equal.

(c) The HP with the test sight during moonlight (.208) and the HP with standard daylight sights (.282) during daylight are equal.

	Degrees of Freedom	Sum Squares	Mean Squares	F Ratio	Results
Item (I)	2	.08383	.04192	6.761	SD
Range (R)	5	.19831	.03966	6.397	SD
Error	10	.06204	.00620		
Total	17	.34418			

Table A-II-1. Results of Analysis of Variance, Stationary, Standard Defense Scenario, M16A1 Rifle, Standard Daylight vs Test Starlight vs Test Moonlight

(2) The HP against stationary targets for the test and control sights under both starlight and moonlight were compared using analysis of variance at the .10 level of significance. Significant differences were isolated using a Scheffe Multiple Range Test. The results of this analysis are shown in Table A-II-2 and indicate that:

(a) The HP with the test (.208) and control (.159) sights are equal under moonlight conditions.

(b) The HP with either test or control sight is higher in moonlight than in starlight.

(c) The HP with the test and control sights under starlight conditions are equal.

(d) Overall, the HP with the test sight (.152) is higher than the HP with the control (.112) sight.

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F Ratio	Results
Item (I)	1	.04067	.04067	7.289	SD
Light (L)	1	.07981	.07981	14.303	SD
IL	1	.00120	.00120	.215	NSD
Range (R)	5	.12634	.02527	4.529	SD
IR	5	.04674	.00935	1.676	NSD
Error	10	.05576	.00558		
Total	23	.35052			

Table A-II-2. Results of Analysis of Variance, Stationary, Standard Defense Scenario, M16A1 Rifle, Test vs Control, Starlight and Moonlight

(3) The timed measures (TFR, TFH) for the test and control items against stationary targets were compared by using simple hypotheses tests. Each test compared the mean for the test item to the mean for the control item and each was evaluated at the .10 level of significance. The results are shown in Table A-II-3 and indicate that:

(a) The mean TFR for the test and control items are equal under both starlight and moonlight conditions. This implies that the soldier can

engage a target as quickly with the control item as he can with the test item under either light condition.

(b) The mean TFH for the test and control items are equal under starlight conditions.

(c) The mean TFH for the test item is significantly less than the mean TFH with the control item under moonlight conditions.

Measure	Light	Item	Mean (Sec)	U Obs	U Critical	Result
TFR	Starlight	Test	6.319	1.255	1.645	NSD
		Control	5.819			
	Moonlight	Test	4.913	.420	1.645	NSD
		Control	4.814			
TFH	Starlight	Test	6.297	- .626	1.645	NSD
		Control	6.951			
	Moonlight	Test	5.581	-1.985	1.645	SD
		Control	6.418			

Table A-II-3. Time Measurement Comparisons, Stationary, Standard Defense Scenario, M16A1 Rifle, Test vs Control

b. Weight and Balance Scenario (Table 8).

(1) The overall HP for the standard sights under daylight conditions and the overall HP for the test sight and control sights under moonlight conditions were compared for the standing and kneeling positions. These comparisons were made using a 3-way Hald proportion test at the .10 level of significance. Significant differences were isolated using 2-way Hald tests. The results are shown in Table A-II-4 and indicate that:

(a) There is no difference in HP when the kneeling position is used with any of the sights.

(b) When the standing position was used, the HP with the standard (.127) and test (.165) sights were equal and both were significantly greater than the HP with the control sight (.071).

Position	Light	Sight	Proportion	Z Obs	Z Critical	Result
Standing	Daylight	Standard	.127	11.483	4.605	SD
	Moonlight	Test	.165			
	Moonlight	Control	.071			
Kneeling	Daylight	Standard	.078	4.553	4.605	NSD
	Moonlight	Test	.098			
	Moonlight	Control	.030			

Table A-II-4. HP Comparisons, Stationary, Weight and Balance Scenario, M16A1 Rifle

(2) The timed measures, TFR and TFH, for the standard sight under daylight conditions, and the test and control sights under moonlight were compared for the standing and kneeling positions. These comparisons were made using simple hypotheses tests and each were evaluated at the .10 level of significance. The results are shown in Table A-II-5 and indicate that:

(a) The responsiveness of the test and control sights is equal under all conditions based on TFR and TFH.

(b) The responsiveness of the test sight is equal to that of the standard sight except for the TFH in the standing position.

3. M14 Rifle.

Defense Scenario (Table 10).

a. The HP against stationary targets for daylight firing with standard sights and for moonlight firing with the test sight were compared using an analysis of variance at the .10 level of significance. Significant differences were isolated using a Scheffe Multiple Range Test. The results of these analyses are shown in Table A-II-6 and indicate that the HP with the test sight during moonlight (.120) and with the standard sights during daylight (.095) are not significantly different.

b. The HP against stationary targets for the test and control sights under moonlight were compared using an analysis of variance at the .10 level of significance. Differences were isolated using a Scheffe Multiple Range Test. The results of this analysis are shown in Table A-II-7 and indicate that the HP for the test item (.120) is significantly lower than the HP with the control item (.206).

Measure	Position	Light	Sight	Mean (Sec)	U Obs	U Critical	Result
TFR	Standing	Daylight	Standard	3.966	1.359	1.645	NSD
		Moonlight	Test	3.560			
		Moonlight	Test	3.560	- .963	1.645	NSD
		Moonlight	Control	3.870			
	Kneeling	Daylight	Standard	3.466	.256	1.645	NSD
		Moonlight	Test	3.364			
		Moonlight	Test	3.364	- .749	1.645	NSD
		Moonlight	Control	4.018			
TFH	Standing	Daylight	Standard	4.312	-2.759	1.645	SD
		Moonlight	Test	6.257			
		Moonlight	Test	6.257	.771	1.645	NSD
		Moonlight	Control	5.582			
	Kneeling	Daylight	Standard	4.370	-1.006	1.645	NSD
		Moonlight	Test	5.239			
		Moonlight	Test	5.239	.747	1.645	NSD
		Moonlight	Control	4.815			

Table A-II-5. Timed Measure Comparisons, Stationary, Weight and Balance Scenario, M16A1 Rifle

Source of Variation	Degrees of Freedom	Sum Squares	Mean Squares	F Ratio	Results
Light	1	.00468	.00468	.837	NSD
Range	5	.03538	.00708	1.267	NSD
Error	5	.02794	.00559		
Total	11	.06800			

Table A-II-6. Results of Analysis of Variance, Stationary Targets, Standard Defense Scenario, M14 Rifle, Daylight vs Moonlight

Source of Variation	Degrees of Freedom	Sum Squares	Mean Squares	F Ratio	Results
Item (I)	1	.01952	.01952	7.625	SD
Range (R)	5	.16237	.03247	12.684	SD
Error	5	.01281	.00256		
Total	11	.19471			

Table A-II-7. Results of Analysis of Variance, Stationary, Standard Defense Scenario, M14 Rifle, Test vs Control

(c) The timed measures, TFR and TFH for the test and control sights were compared using simple hypotheses tests. Each test compared the mean for the test item to the mean for the control item and each was evaluated at the .10 level of significance. The results are shown in Table A-II-8 and indicate that the mean TFR and TFH for the test and control sights are equal under moonlight conditions.

Measure	Mode	Item	Mean	U Obs	U Critical	Result
TFR	Stationary	Test	4.710	1.024	1.645	NSD
		Control	4.455			
TFH	Stationary	Test	5.824	.400	1.645	NSD
		Control	5.599			
TFR	Moving	Test	5.969	- .505	1.645	NSD
		Control	6.311			

Table A-II-8. Time Measurement Comparisons, Standard Defense Scenario, M14 Rifle, Test vs Control

4. M60 Machine Gun.

Defense Scenario (Table 12).

a. The HP against stationary targets for daylight firing with standard sights and for moonlight and starlight with the test item were compared using an analysis of variance at the .10 level of significance.

Differences were isolated using a Scheffe Multiple Range Test. The results of these analyses are shown in Table A-II-9 and indicate that:

(1) The HP with the test sight under starlight conditions (.111) is equal to the HP with the standard daylight sight during daylight firing (.027).

(2) The HP with the test sight under moonlight conditions (.172) is significantly greater than the HP with the standard sight during daylight firing (.027).

Source of Variation	Degrees of Freedom	Sum Squares	Mean Squares	F Ratio	Results
Light (L)	2	.08173	.04086	8.941	SD
Range (R)	5	.09323	.01865	4.081	SD
Error	10	.04572	.00457		
Total	17	.22067			

Table A-II-9. Results of Analysis of Variance, Stationary, Standard Defense Scenario, M60 Machine Gun, Daylight vs Starlight vs Moonlight

b. The timed measures, TFR and TFH, for the test sight are shown in Table 13 but were not analyzed because brackets were not available for the control sight.

5. M67 (90-mm Recoilless Rifle) (Table 14).

The hit/miss data for the daylight firing was compared to the night firing results with the test sight. A 2 X 2 Chi-squared contingency table at the .10 level of significance was used to compare the proportions. The results are shown in Table A-II-10 and indicate that the HP for day and night firings are equal. The criterion expressed in paragraph 2.7.2.1 is met by the test item when employed on the M67.

	Day	Night	X^2 Calculated	X^2 Critical	Result
Hit	26	32	1.746	2.706	NSD
Miss	19	13			
HP	.578	.711			

Table A-II-10. M67 Firing Analysis

6. M72A2 LAW (Table 15).

The hit/miss data for the daylight firing was compared to the night firing results with the test sight. A 2 X 2 Chi-squared contingency table at the .10 level of significance was used to compare the proportions. The results are shown in Table A-II-11 and indicate that the HP for day and night firings are equal. The criterion expressed in paragraph 2.7.2.1 is met by the test item when employed on the M72A2.

	Day	Night	X^2 Calculated	X^2 Critical	Result
Hit	35	28	2.593	2.706	NSD
Miss	10	17			
HP	.778	.622			

Table A-II-11. M72A2 Firing Analysis

7. M79 Grenade Launcher.

The hit/miss data for the M79 daylight firing was compared to the night firing results with the AN/PVS-4, Table 16. A 2 X 2 Chi-squared contingency table at the .10 level of significance was used to compare the proportions. The results are shown in Table A-II-12 and indicate that there is no significant difference between HP for the M79 during daylight with standard sights and at night with the AN/PVS-4. The criterion expressed in paragraph 2.7.2.1 is met by the test item when employed on the M79.

	Day	Night	X^2 Calculated	X^2 Critical	Result
Hit	21	14	1.976	3.84	NSD
Miss	39	46			
HP	.350	.233			

Table A-II-12. M79 Firing Analysis

8. M203 Grenade Launcher.

The hit/miss data for the M203 daylight firing was compared to the night firing results with the AN/PVS-4, Table 17. A 2 X 2 Chi-squared contingency

table at the .10 level of significance was used to compare the proportions. The results are shown in Table A-II-13 and indicate that the HP with the M203 and standard signts during daylight is significantly higher than the HP with the M203 and AN/PVS-4 at night. The criterion expressed in paragraph 2.7.2.1 is not met by the test item when employed on the M203.

	Day	Night	X^2 Calculated	X^2 Critical	Result
Hit	13	5			
Miss	47	55	4.18	3.84	SD
HP	.217	.083			

Table A-II-13. M203 Firing Analysis

PART III - TABLES

LIGHT BAND	RANGE BAND	TEST SIGHT RATIO	TEST SIGHT P(D)	CONTROL SIGHT RATIO	CONTROL SIGHT P(D)	REMARKS*
Moonlight	25-199	91/94	.968	122/128	.953	Test = Cont
	200-399	55/57	.965	71/78	.910	Test = Cont
	400-600	47/58	.810	65/85	.765	Test = Cont
	Overall	193/209	.923	258/291	.887	Test = Cont
Starlight	25-199	118/120	.983	130/131	.992	Test = Cont
	200-400	94/114	.825	96/134	.716	Test > Cont
	Overall	212/234	.906	126/165	.764	Test > Cont

Table A-1. Single Man Targets and Number Detected/Total (Test Area I) (Moonlight and Starlight)

*Based on Hald Proportion Test at the .10 level of significance.

LIGHT BAND	RANGE BAND	TEST SIGHT RATIO	TEST SIGHT P(D)	CONTROL SIGHT RATIO	CONTROL SIGHT P(D)	REMARKS*
Moonlight	25-199	120/120	1.000	129/130	.992	Test = Cont
	200-399	61/100	.610	31/60	.517	Test = Cont
	400-600	14/80	.175	20/80	.250	Test = Cont
	Overall	195/300	.650	180/270	.667	Test = Cont
Starlight	25-199	110/117	.940	103/108	.954	Test = Cont
	200-400	36/99	.364	57/126	.452	Test = Cont
	Overall	146/216	.676	160/234	.684	Test = Cont

Table A-2. Single Man Targets and Number Detected/Total (Test Area II) (Moonlight and Starlight)

*Based on Hald Proportion Test at the .10 level of significance.

LIGHT BAND	RANGE BAND	TEST SIGHT		CONTROL SIGHT		REMARKS*
		RATIO	P(R)	RATIO	P(R)	
Moonlight	25-199	90/94	.957	117/128	.914	Test = Cont
	200-399	50/57	.877	62/78	.795	Test = Cont
	400-600	41/58	.707	53/85	.624	Test = Cont
	Overall	181/209	.866	232/291	.797	Test > Cont
Starlight	25-199	116/120	.967	116/131	.885	Test > Cont
	200-400	72/114	.632	79/134	.590	Test = Cont
	Overall	188/234	.803	195/265	.736	Test > Cont

Table A-3. Single Man Targets and Number Recognized/Total (Test Area I) (Moonlight and Starlight)

At 600 meters under moonlight conditions, the test sight ratio was 14/20 and the P(R) is .700.

At 400 meters under starlight conditions, the test sight ratio was 21/52 and the P(R) is .519.

*Based on Hald Proportion Test at the .10 level of significance.

LIGHT BAND	RANGE BAND	TEST SIGHT		CONTROL SIGHT		REMARKS*
		RATIO	P(R)	RATIO	P(R)	
Moonlight	25-199	120/120	1.000	127/130	.977	Test > Cont
	200-399	58/100	.580	29/50	.580	Test = Cont
	400-600	10/80	.125	9/80	.113	Test = Cont
	Overall	188/300	.627	165/260	.635	Test = Cont
Starlight	25-199	108/117	.923	102/108	.944	Test = Cont
	200-400	34/99	.343	55/126	.437	Test = Cont
	Overall	142/216	.657	157/234	.671	Test = Cont

Table A-4. Single Man Targets and Number Recognized/Total (Test Area II) (Moonlight and Starlight)

*Based on Hald Proportion Test at the .10 level of significance.

Light Band	Range (Meters)	Test Sight		Control Sight	
		Ratio	P(D)	Ratio	P(D)
Moonlight	25	123/125	.984	136/139	.978
	50	119/120	.992	177/181	.978
	100	152/155	.981	182/186	.978
	200	126/146	.863	122/138	.884
	300	91/145	.628	86/140	.614
	400	77/147	.524	106/195	.544
	600	52/138	.377	56/165	.339
	Overall	740/976	.758	865/1144	.756
Starlight	25	127/129	.984	137/139	.986
	50	172/174	.989	126/130	.969
	100	157/165	.952	170/177	.960
	200	94/119	.790	121/165	.733
	300	76/120	.633	87/164	.530
	400	100/180	.556	88/163	.540
	600	69/150	.460	57/153	.373
	Overall	795/1037	.767	786/1091	.720
TOTAL		1535/2013	.763	1651/2235	.739

Table A-5. Single and Multiple Man Targets Detected/Total (Test Areas I and II) (Moonlight and Starlight)

Light Band	Range (meters)	Test Sight		Control Sight	
		Ratio	P(R)	Ratio	P(R)
Moonlight	25	121/125	.968	133/139	.957
	50	118/120	.983	175/181	.967
	100	146/155	.942	169/186	.909
	200	114/146	.781	108/138	.783
	300	72/145	.497	70/140	.500
	400	53/147	.361	72/195	.369
	600	32/138	.232	29/165	.176
	Overall	656/976	.672	756/1144	.661
Starlight	25	123/129	.953	131/139	.942
	50	163/174	.937	117/130	.900
	100	139/165	.842	155/177	.876
	200	82/119	.689	96/165	.582
	300	45/120	.375	59/164	.360
	400	60/180	.333	54/163	.331
	600	27/150	.180	32/153	.209
	Overall	639/1037	.616	644/1091	.590
TOTAL		1295/2013	.643	1400/2235	.625

Table A-6. Single and Multiple Man Targets Recognized/Total (Test Areas I and II) (Moonlight and Starlight)

Light Band	Range (meters)	Test Sight		Control Sight	
		Ratio	P(I)	Ratio	P(I)
Moonlight	25	97/126	.770	99/139	.712
	50	78/120	.650	113/181	.624
	100	50/155	.323	62/186	.333
	200	6/146	.041	7/138	.051
	300	1/145	.007	2/140	.014
	400	3/147	.020	4/195	.021
	600	1/138	.007	0/165	.000
	Overall	236/976	.242	287/1144	.251
Starlight	25	77/129	.597	91/139	.655
	50	72/174	.414	49/130	.377
	100	12/165	.073	19/177	.107
	200	5/119	.042	4/165	.024
	300	2/120	.017	5/164	.030
	400	5/180	028	2/163	.012
	600	4/150	.027	1/153	.007
	Overall	177/1037	.171	171/1091	.157
TOTAL		413/2013	.205	458/2235	.205

Table A-7. Single and Multiple Man Targets Identified/Total (Test Areas I and II) (Moonlight and Starlight)

DATES	TEST AREA	MOONLIGHT	STARLIGHT
10 Jun - 9 Jul	I	3.8×10^{-2} max 2.5×10^{-3} mean 1.2×10^{-3} min	3.7×10^{-4} max 1.9×10^{-4} mean 1.2×10^{-4} max
3 Jul - 31 Jul	II	6.9×10^{-3} max 3.3×10^{-3} mean 1.7×10^{-3} min	3.4×10^{-4} max 2.6×10^{-4} mean 1.3×10^{-4} min
15 Oct - 30 Oct	III	4.0×10^{-2} max 2.3×10^{-2} mean 3.3×10^{-3} min	3.7×10^{-4} max 1.8×10^{-4} mean 1.3×10^{-4} min

Table A-8. Illumination Data (in foot candles)

	AN/PVS-4		Control	
	Day	Night	Day	Night
M (secs)	62.2	92.5	23.4	43.4
s	41.1	53.6	14.5	16.8
n	55	55	62	53
D (secs)	36.4	46.7	19.8	35.9
s	15.5	25.1	11.3	18.9
n	50	50	60	50
Z (min)	80.9	21.3	20.2	27.6
s	25.6	10.5	8.4	9.8
n	5	4	4	5
R (rounds)	34.2	18.0	13.7	22.4
s	14.2	2.4	4.4	7.9
n	5	4	6	5

M - mean time to mount sight; D - mean time to dismount sight; Z - mean time to zero weapon; R - mean number of rounds to zero; s - standard deviation; n - sample size

Excessive times to zero were due to the light conditions.

Table A-9. Mounting Bracket and Zeroing Data, Subtest 6, Mounting Bracket, Sight Reticle, and Sight Adjustment, M14 Exercise

	AN/PVS-4		Control	
	Day	Night	Day	Night
M (secs)	47.9	45.9	39.7	58.7
s	60.2	43.8	30.4	59.4
n	44	66	43	54
D (secs)	6.8	10.3	21.6	20.3
s	3.3	6.0	9.9	15.6
n	40	60	40	50
Z (min)	78.7	28.3	25.8	18.5
s	41.6	17.6	10.7	3.0
n	4	5	4	5
R (rounds)	28.8	15.6	19.5	15.0
s	8.4	4.4	5.7	2.5
n	4	5	4	4

Table A-10. Mounting Bracket and Zeroing Data, Subtest 6, Mounting Bracket, Sight Reticle, and Sight Adjustment, M16A1 Exercise

	AN/PVS-4	
	Day	Night
M (secs)	210.3	254.4
s	179.2	204.4
n	54	55
D (secs)	218.1	145.8
s	220.4	76.6
n	50	50
Z (min)	21.7	20.5
s	13.9	9.2
n	5	5
R (rounds)	13.2	11.0
s	8.1	4.6
n	5	3

Table A-11. Mounting Bracket and Zeroing Data, Subtest 6, Mounting Bracket, Sight Reticle, and Sight Adjustment, M60 Exercise

	AN/PVS-4	
	Day	Night
M (secs)	67.3	110.7
s	24.6	33.4
n	55	55
D (secs)	67.7	103.6
s	22.0	37.3
n	50	50
Z (min)	20.1	21.5
s	20.2	13.0
n	5	5
R (rounds)	6.2	7.0
s	5.0	2.7
n	5	5
Hit Probability	$\frac{121}{150} = .807$	$\frac{144}{150} = .960$

Table A-12. Mounting Bracket and Zeroing Data, Subtest 6, Mounting Bracket, Sight Reticle, and Sight Adjustment, M79 Exercise

	AN/PVS-4	
	Day	Night
M (secs)	64.2	71.9
s	42.7	54.9
n	44	55
D (secs)	33.6	33.6
s	17.5	10.8
n	40	50
Z (min)	43.2	41.2
s	23.9	6.3
n	3	5
R (rounds)	21.8	29.0
s	11.6	5.8
n	4	5
Hit Probability	$\frac{58}{150} = .387$	$\frac{29}{150} = .193$

Table A-13. Mounting Bracket and Zeroing Data, Subtest 6, Mounting Bracket, Sight Reticle, and Sight Adjustment, M203 Exercise

	AN/PVS-4	
	Day	Night
M (secs)	96.2	79.6
s	64.9	60.4
n	31	29
D (secs)	44.4	39.4
s	55.8	13.3
n	27	28
Z (min)	3.4	6.7
s	1.0	2.0
n	3	4
Hit Probability	$\frac{17}{27}$ = .630	$\frac{9}{30}$ = .300

Table A-14. Mounting Bracket and Zeroing Data, Subtest 6, Mounting Bracket, Sight Reticle, and Sight Adjustment, M72A2 Exercise

	AN/PVS-4	
	Day	Night
M (secs)	19.5	24.3
s	5.2	18.2
n	13	12
D (secs)	20.1	21.8
s	3.6	10.6
n	15	14
Hit Probability	$\frac{12}{14} = .857$	$\frac{14}{15} = .933$

Table A-15. Mounting Bracket and Zeroing Data, Subtest 6, Mounting Bracket, Sight Reticle, and Sight Adjustment, M67 Exercise

	AN/PVS-4		Control	
	Day	Night	Day	Night
0 at zero	1.5	.7	1.0	1.1
s	.4	.2	.3	.3
n	5	5	6	5
0 after 1 dismounting	2.7	1.4	1.5	1.4
s	1.9	.7	.8	.4
n	5	5	6	5
0 after 5 dismountings	3.1	2.0	1.4	1.5
s	2.4	1.4	.4	.9
n	5	5	6	5
0 after 10 dismountings	3.8	2.2	1.2	1.1
s	1.4	1.3	.5	.4
n	5	5	6	5

Table A-16. Mean Offset (0) in Inches for M14

	AN/PVS-4		Control	
	Day	Night	Day	Night
0 at zero	.7	.8	.5	.5
s	.2	.2	.2	.1
n	4	6	4	5
0 after 1 dismounting	1.8	1.2	.7	1.4
s	.7	.6	.4	.7
n	4	6	4	5
0 after 5 dismountings	1.8	1.8	1.2	.9
s	.7	1.5	.9	.7
n	4	6	4	5
0 after 10 dismountings	1.3	1.4	1.5	.8
s	1.0	.8	.7	.3
n	4	6	4	5

Table A-17. Mean Offset (0) in Inches for M16A1

	AN/PVS-4	
	Day	Night
0 at zero	.6	.7
s	.1	.3
n	5	5
0 after 1 dismounting	1.5	2.9
s	.7	1.6
n	5	5
0 after 5 dismountings	1.9	2.4
s	.4	.6
n	5	5
0 after 10 dismountings	1.9	3.1
s	.6	1.7
n	5	5

Table A-18. Mean Offset (0) in Inches for M60

Retention of Zero Test Sight at Night with	Comparison	Mean O	t Calc	t Crit	Result
M14	Zero	.7	2.046	2.132	NSD
	1 Dismount	1.4			
	Zero	.7	2.087	2.132	NSD
	5 Dismounts	2.0			
	Zero	.7	2.435	2.132	SD
	10 Dismounts	2.2			
M16	Zero	.8	1.864	2.015	NSD
	1 Dismount	1.2			
	Zero	.8	1.596	2.015	NSD
	5 Dismount	1.8			
	Zero	.8	1.927	2.015	NSD
	10 Dismounts	1.4			
M60	Zero	.7	2.980	2.132	SD
	1 Dismount	2.9			
	Zero	.7	5.010	2.132	SD
	5 Dismounts	2.4			
	Zero	.7	3.158	2.132	SD
	10 Dismounts	3.1			

Table A-19. Comparison Testing on Mean Offset (O)

SIGHT	M16 ROUNDS	M14 ROUNDS
0036	631	310
0037	617	280
0038	694	320
0053	783	370
0057	667	303
0061	714	470
0085	736	335
0087	640	271
0089	690	460
0096	710	390
GRAND TOTAL	6882	3508

Table A-20. Round Count, AN/PVS-2B

SIGHT	M16 ROUNDS	M14 ROUNDS	M60 ROUNDS	M79 40-MM ROUNDS	M203 40-MM ROUNDS	M67 ROUNDS	M72A2 ROUNDS
120	908	398	1204	80	135	43	59
121	697	395	1150	45	90	42	37
122	700	396	1240	95	60	-	40
123	698	440	1320	164	30	-	54
124	784	371	1207	106	58	86	45
125	171	56	58	30	62	55	36
126	763	302	69	99	132	-	25
127	792	467	72	70	102	36	-
128	704	422	42	82	30	15	-
129	833	320	117	72	123	-	29
GRAND TOTAL	7050	3567	6479	842	759	274	325

Table A-21. Round Count, AN/PVS-4

TEST SIGHT	SIGHT SERIAL NUMBER	OPERATING TIME	FAILURES
1	120	602:36	1
2	121	567:44	1
3	122	573:21	1
4	123	609:35	
5	124	549:25	4
6	125	514:43	4
7	126	570:59	3
8	127	581:46	2
9	128	593:37	1
10	129	611:31	

Table A-22. Operating Time of Test Sights (Time in Hours and Minutes)

CONTROL SIGHT	SIGHT SERIAL NUMBER	OPERATING TIME	FAILURES
1	0036	440:15	
2	0037	439:45	1
3	0038	440:15	
4	0053	440:15	
5	0057	440:15	
6	0061	440:15	
7	0085	440:15	
8	0087	440:15	
9	0089	440:15	
10	0096	440:15	

Table A-23. Operating Time of Control Sight (Time In Hours and Minutes)

Range (meters)	Single Targets		Multiple Targets		Overall
	Ratio	P(R)	Ratio	P(R)	
25	12/16	.750	--	--	.750
50	20/24	.833	20/24	.833	.833
100	13/16	.813	12/16	.750	.781
200	6/8	.750	21/32	.656	.675
300	15/24	.625	8/16	.500	.575
400	13/24	.542	10/24	.417	.479
Overall	79/112	.705	71/112	.632	.669

Table A-24. P(R) on Tactical Observations (Transportability/Portability Subtest)

PART IV - QUESTIONNAIRES

TACTICAL OBSERVATION
AN/PVS-2, AN/PVS-4 Interview

NO OF RESPONSES

1. Do your eyes ever feel different after extended observation with the AN/PVS-4?

a. Yes 4
b. No 6

Comments:
(Yes) Hurt, watered for several minutes. 1
(Yes) Aches, jumps. 1
(Yes) Temporary fuzziness 5-10 minutes. 1

2. Do your eyes ever feel different after extended observation with the AN/PVS-2?

a. Yes 4
b. No 6

Comments:
(Yes) Temporary fuzziness 5-10 minutes. 1
(Yes) Aches, jumps. 1
(Yes) Hurt, watered for several minutes. 1

3. If you answered "yes" to either of the above, describe that feeling.

Eyebrow, eye socket becomes sore from pressing in on rubber eye cup. 1
Bothered some, but only for the 1st few days. 1

4. Have you ever had trouble adjusting the controls to suit your eyes?

a. Yes 4
b. No 6

Comments:
(Yes) PVS-4 only-could not get a fine focus with large focus ring. 1
(Yes) PVS-2 only-range focus ring binds. 1
(Yes) PVS-2 front ring (range focus) binds. 1
(Yes) When there is haze, fog (both scopes). 1

5. If you answered "yes" to question 4, describe that time - which sight, which control, what was the problem, how did you solve it?

PVS-4 only-could not get a fine focus with large focus ring. 1
PVS-2 only-range focus ring binds. 1
PVS-2 front ring (range focus) binds. 1
When there is haze, fog (both scopes). 1

NO OF RESPONSES

6. Do you ever experience any other physical discomforts during or after use of the AN/PVS-2?

a. Yes	1
b. No	9

Comments:

(Yes) Headache, sick one night.	1

7. Do you ever experience any other physical discomforts during or after use of the AN/PVS-4?

a. Yes	1
b. No	9

Comments:

(Yes) Headache, sick one night.	1

8. If you answered "yes" to either question 6 or 7, describe that discomfort.

Headache, sick one night.	1

9. When bright lights appear in your field of view what happens to your ability to see things near those lights?

a. With the AN/PVS-2?	
It's impossible-blinds you w/big white glare.	1
It blocks it out-all goes green.	1
Blinding-leaves traces through it.	1
It streaks on the glass-illuminated.	1
It's all glare-you can see light but not the man by the light.	1
A ring of light forms on the sight.	1
My eye gets a dark spot in it for a few seconds, then it goes away.	1
Can't see anything near the light.	1
Glare-but I can still see target.	1
Can't see it-it flashes, hurts my eyes.	1

NO OF RESPONSES

b. With the AN/PVS-4?

Can't see it-it flashes,hurts my eyes.	1
Glare-but I can still see target.	1
Still bad, but you can distinquish a little near the light.	1
My eye gets a dark spot in it for a few seconds, then it goes away.	1
A ring of light forms on the sight.	1
Less glare than with PVS-2.	1
Totally blots out the light and the dark things near the light.	1
It gets bright but it doesn't leave "spider webs" like the PVS-2-not as blinding.	1
It blocks it out-all goes green.	1
It's impossible-blinds you with big white glare.	1

10. Which sight was least affected by the bright light? (which could you clearly see closest to the bright light source?)

AN/PVS-2	1
AN/PVS-4	9

11. Do you have any trouble adjusting the controls with your bare hands?

a. Yes	3
b. No	7

Comments:

(Yes) Ring at objective lens (PVS-2) binds.	1
(Yes) Focus ring, PVS-4.	1
(Yes) PVS-4 needs a tool to adjust reticle position.	1
(Yes) PVS-4 "runs out of brightness" on the top end of the control.	1

12. Which sight produced the most clear, detailed picture?

AN/PVS-2	2
AN/PVS-4	7
Both were equal	1

Comments:

One respondent indicated both and explained as follows:

PVS-2 is clearest at close ranges.
PVS-4 is clearest at long ranges because it focuses better.

NO OF RESPONSES

13. Which sight produced the best level of brightness or dimness?

AN/PVS-2	1
AN/PVS-4	9

14. Which sight would you prefer to use for night tactical observation for long periods (over 4 hours at one time)?

AN/PVS-2	1
Comments:	
It seems more accurate, clearer, brighter.	1
AN/PVS-4	9
Comments:	
You can control brightness and turn out the reticle. PVS-4 has better reticle, plus range determination is better.	1
You can adjust brightness, plus it has a better reticle range determination ability.	1
Better brightness control and range, but it's no good for firing because it's hard to zero and the reticle moves when you fire.	1
Shows better view, range estimation better.	1
In moonlight it gives a clearer picture.	1
Only if they'd change the eyecup so it would not turn and rasp your eye when you focus.	1
Clearer picture-can adjust picture brightness.	1
Clearer picture, adjustable brightness, better range determination, depth of field with or without reticle.	1
PVS-4 quality constant, PVS-2 quality varied. PVS-4 better at long range.	1

PORTABILITY INTERVIEW M60

NO OF RESPONSES

1. Did the AN/PVX-4 and M60 system combination catch on brush or vines?

Yes - Three times, caught between scope and weapon at front of bracket, but the M60 mostly hung up, not the scope.	1

2. What suggestions, if any, do you have for improving the AN/PVS-4 and M60 combination system?

To mount it you have to remove the feed tray cover. That can take up to about 15 minutes in the dark. It needs some equally stable way to mount without having to take off the feed cover. It holds its zero well though.	1

PORTABILITY INTERVIEW M72

3. Did the AN/PVS-4 and M72 system combination catch on brush or vines?

No - It never hung up on anything, but the rear end cap came off the LAW.	1

4. What suggestions, if any, do you have for improving the AN/PVS-4 and M72 combination system?

The sight doesn't really add that much weight to the LAW. You could hardly feel it. But it should be made smaller in length and width for the LAW.	1

PORTABILITY INTERVIEW M67

NO OF RESPONSES

1. Did the AN/PVS-4 and M67 systems catch on brush or vines?

a. Yes	3
b. No	1

Comments:

(Yes) Breech caught on vines.	1
(Yes) Breech handle caught on vines but PVS-4 did not catch or snag.	1
(Yes) PVS-4 breech handle caught on vines. Its no different from the regular sight but heavier.	1

2. What suggestions, if any, do you have for improving the AN/PVS-4 and M67 combination system?

a. Sight and mounting bracket could be made smaller, sight smaller in diameter.	2
b. They should make the case so it covers the sight when it's mounted on the 90 and can be taken off quickly.	1

STARLIGHT SCOPES QUESTIONNAIRE
AN/PVS-4, AN/PVS-2

Starlight scopes are currently undergoing test. You have used the Night Vision Sights, AN/PVS-4 and AN/PVS-2, as night observation devices and sights. Since you have been involved in the testing and evaluation of these scopes, your opinions are very important. Please answer all questions as accurately as you are able. Most of the questions allow space for comments in addition to answers to the questions. Use these spaces to give any additional information helpful to an evaluation of the starlight scopes.

Name_____ Age_____

Rank_____ Duty MOS_____ Time in Service_____

1. How would you rate the ease of using the AN/PVS-4? (Circle the appropriate letter)

	# OF RESPONSES
a. Very easy	4
b. Easy	5
c. Difficult	0
d. Very difficult	0

Comments:
(Very easy) Can adjust it more. It gives better range estimation. 1

2. How would you rate the ease of using the AN/PVS-2? (Circle the appropriate letter)

a. Very easy	2
b. Easy	6
c. Difficult	1
d. Very difficult	0

3. Which scope caused the least eye fatigue when used for observation for long periods of time? (Circle the appropriate letter)

a. AN/PVS-4	2
b. AN/PVS-2	0
d. No difference	7

Comments:
(AN/PVS-4) But the eyepiece cup caused friction on my eye while focusing. 1
(No difference) AN/PVS-2 was used for tactical observation only. 2

OF RESPONSES

4. Which scope permits the most stable and comfortable grip? (Circle the appropriate letter)

a.	AN/PVS-4	8
b.	AN/PVS-2	0
c.	No difference	1

5. Did the tube brightness control on the AN/PVS-4 help you to obtain a better sight picture? (Circle the appropriate letter)

a.	Yes	9
b.	No	0

6. During observation exercises, test soldiers differed in opinion as to the best method of regulating the tube brightness control knob of the AN/PVS-4. Which method most closely describes the manner in which you regulated the control? (Circle the appropriate letter)

a.	I always kept the picture as bright as possible.	2
b.	I regulated the brightness control knob each time I observed.	1
c.	I normally set the brightness control knob at a particular brightness which seemed best for the set of conditions under which I was observing. I changed it only when the conditions changed, e.g., moonlight, starlight, terrain, etc.	2
d.	I adjusted the tube brightness according to the range at which I was trying to observe.	1
e.	(1) A combination of b and f best describes the manner in which I adjusted the tube brightness control.	1
	(2) A combination of c and d best describes the manner in which I adjusted the tube brightness control.	1
	(3) A combination of c and f best describes the manner in which I adjusted the tube brightness control.	1

Comments: (f) Normally dimmest setting possible. 2

7. Does the AN/PVS-4 enable you to see through haze? (Circle the appropriate letter)

a.	Yes	3
b.	No	6

Comments:	(Yes) More than PVS-2.	1
	(Yes) Moderately.	1
	(No) Could not see through fog or haze.	1

OF RESPONSES

8. Which method best describes the way you use the objective focusing ring on the AN/PVS-4 and the AN/PVS-2? (Circle the appropriate letter)

a. I adjust the objective focusing ring to correspond with the particular range at which I am attempting to define targets.	2
b. I adjust the objective focusing ring to a particular setting which I think is best for all ranges. I seldom change it once I am satisfied with the setting.	3
c. I continuously adjust my objective focusing ring each time I observe an array of targets.	4

9. Are the AN/PVS-4 controls listed below conveniently located and sensitive to touch?

	Yes	No
a. Off/on switch	7	2
b. Reticle brightness	7	2
c. Diopter ring	8	1
d. Objective focusing ring	8	1
e. Tube brightness control	7	2

10. How easy was it to locate the range focusing ring on the AN/PVS-4 in the dark? (Circle the appropriate letter)

a. Very easy	7
b. Easy	2
c. Difficult	0
d. Very difficult	0

11. Did you experience eye fatigue during any of the observation exercises? (Circle the appropriate letter)

a. Yes	5
b. No	3
No response	1

Comments:

(Yes) When firing.	1
(Yes) Right eye hurts, jumps.	1
(No response) Only when firing M-79, M-203.	1

OF RESPONSES

12. If answer to question 11 is "yes" can you associate the fatigue with a particular type of terrain, light condition, or type sight? (Circle the appropriate letter)

a. No	3
b. Yes, if yes, circle the appropriate letters	3
No response	3
a. Moonlight	3
b. Starlight	1
c. Open terrain	1
d. Terrain with brush	2
e. Night sight, AN/PVS-4	1
f. Night sight, AN/PVS-2	2

Comments:

(No) Only at the beginning (for 5-10 minutes) of each viewing time.	1
(No response) Don't know any further than that it was with moonlight conditions.	1

13. Did you experience lens fogging during the observation exercises? (Circle the appropriate letter)

a. No	2
b. Yes I experienced lens fogging while using the: (Circle as many as necessary)	
a. AN/PVS-4, night sight	0
b. AN/PVS-2, Starlight Scope	0
c. AN/PVS-4 and AN/PVS-2	7

14. Do you have difficulty identifying any of the controls during darkness? (Circle the appropriate letter)

a. Yes, with the AN/PVS-2	2
b. Yes, with the AN/PVS-4	0
c. Yes, with both sights	1
d. Not, with either sight	6

Comments:

(a) Battery emplacement.	1
(c) Had to take it away from the eye to adjust reticle brightness.	1
(d) Not unless you don't know how it works	1

OF RESPONSES

15. These questions are applicable only to personnel who wear eyeglasses:

a. Is the AN/PVS-4 compatible with eyeglasses? (Can you use it while wearing glasses?) (Circle the appropriate letter)

a. Yes	0
b. No	3
Not applicable	6

Comments:

(No) Very hard to use while wearing glasses.	1

b. Which method describes the manner in which you employ the sight? (Circle the appropriate letter)

a. I wear my glasses	0
b. I remove my glasses and adjust the diopter setting to suit my eyes.	3
Not applicable	6

16. The AN/PVS-4 has a wider field of view than does the AN/PVS-2. Did this capability change your ability to detect targets while using the AN/PVS-4? (Circle the appropriate letter)

a. No	6
b. Yes	2
No response	1

17. Some sights appeared to be characterized by excessive scintillation (snowy screen).

a. Was this the case with the sights you used? (Circle the appropriate letter.

a. Yes - PVS-2	2
b. Yes - PVS-4	1
c. No	0
No response	6

Comments:

(No) On one PVS-2 only.	1

b. Was the scintillation (snowy screen) bothersome to your eyes? (Circle the appropriate letter)

a. Yes	2
b. No	1
No response	6

c. Did it make the target observation more or less difficult? (Circle the appropriate letter)

a. More difficult	3
b. Less difficult	0
No response	6

OF RESPONSES

18. If you answered "yes" to question 16, briefly state HOW the wider field of view affected your ability to detect targets.

I can see clearer.	1
I could see in depth which target I was looking at.	1

19. Which scope had the most scintillation (snowy screen)? (Circle the appropriate letter)

a. AN/PVS-4	1
b. AN/PVS-2	3
c. Neither one had any	5
d. Both scopes had it	0

Comments:

(AN/PVS-4) On tactical observation only.	1

20. Which method best describes the manner in which you employ the night vision sight? (Circle the appropriate letter)

a. I keep one eye closed while observing	8
b. I keep both eyes open while observing	0
c. I keep both eyes open while scanning for targets. When I think that I have detected something significant, I close one eye.	1

21. Which scope would you prefer to use: (Check one box for every letter)

	AN/PVS-4	AN/PVS-2	No Opinion
a. For long ranges (400-600 meters)	8	0	1
b. For short ranges (25-400 meters)	8	1	0
c. For medium ranges	8	0	1
d. For detection	9	0	0
e. For recognition	8	0	1
f. For identification	7	1	1
g. Under starlight conditions	8	0	1
h. Under moonlight conditions	8	1	0

OF RESPONSES

22. With which scope can you best estimate the range of targets? (Circle the appropriate letter)

a. AN/PVS-4	8
b. AN/PVS-2	0
c. About the same	1

Comments:

(AN/PVS-4) Ranging stadia & reticle far superior.	1

23. Which scope is the easiest to learn to operate properly? (Circle the appropriate letter)

a. AN/PVS-4	4
b. AN/PVS-2	1
c. About the same	4

Comments:

(AN/PVS-4) I had trouble with PVS-2 reticle.	1
(About the same) Neither one is hard.	1

24. During the past 90 days you have employed the Night Vision Sight, AN/PVS-4 under varying light conditions. Based on this experience do you consider the sight a valuable night vision aid? (Circle the appropriate letter)

a. Yes	9
b. No	0

25. Is the AN/PVS-4 sight an aid to night vision under all conditions, e.g., brush, open terrain, thickly wooded, moonlight and starlight conditions? (Circle the appropriate letter)

a. Yes	5
b. No	4

Comments:

(Yes) No good in fog.	1
(No) No good in woods.	2

26. Overall, which of these two sights would you prefer to use? (Circle the appropriate letter)

a. AN/PVS-4	9
b. AN/PVS-2	0

OF RESPONSES

27. In the space provided, make any other comments you believe would be important in the assessment of the AN/PVS-4 and the AN/PVS-2.

Reticles need some improvement.	1
Repair AN/PVS-4 reticles.	1
Tube brightness control repair needed in PVS-4's.	1
AN/PVS-2 needs range estimation scale.	1

APPENDIX B - TEST FINDINGS

SECTION 1. TEST CRITERIA

Criteria were extracted from the approved QMR for Individual and Crew-Served Night Vision Sights, 2 Mar 64, and stated by USAIB. Underlined portions of listed requirements are not applicable to this test.

Item	Source	Criteria	Applicable Subtest	Remarks
		A. QMR Requirements		
1	para 7a(1)	Range. (Essential) Recognize a standing man from 25 to at least 400 meters in clear air in starlight and 25 to at least 600 meters in clear air and moonlight.	2.4	Met (para 2.4.5.1, Partial Report (PR), and para 2.4.5.1, Final Report (FR)).
2	para 7b(1)	Field of view (Minimum) (Essential): At least 185 mils		Determined by the engineering test.
3	para 7c	(Essential) Magnification is required (approximately 4X for the individual weapon sight		Determined by the engineering test.
4	para 7d	(Desirable) During ambient light conditions less than starlight, these sights will be usable in conjunction with invisible light sources to increase range. Otherwise sights will be completely passive. The sights will also have a capability of detecting enemy use of near infrared emitters.	2.4	Met (para 2.4.5.6, PR).
5	para 7e	Capability to see through enemy camouflage is desirable.	2.4	Not met. The sight does not provide the user with the capability of seeing through enemy camouflage (para 2.4.5.7, PR).

Item	Source	Criteria	Applicable Subtest	Remarks
6	para 7f	These sights shall be operable under the basic operating conditions as defined in AR 705-15.	2.9	Determined by the engineering test.
7	para 7g	Sights must be capable of use with gas mask, M14 and M17 and their future replacements.	2.11	Met (para 2.11.5.6, PR).
8	para 7i	The sight will have a 90% probability of performance without failure for 1,000 operating hours under the basic operating conditions of para 7a, AR 705-15.	2.11	Determination to be made by appropriate agencies based on results of the overall test program.
9	para 8a(1)	Weight (including integral power source) (Essential) not more than 4 pounds, 2 pounds desirable.		Determined by the engineering test.
10	para 8b(1)	(Essential) Size will be as small as possible, consistent with other characteristics, but must not exceed lengths given below and must not degrade man portability and performance characteristics of weapon with which the sight is to be employed: Not more than 11 inches long.	2.8	Met (para 2.8.5.2, FR).
11	para 8c	(Essential) A mounting bracket will be developed for each of the weapons listed in ***, taking into account the method of employment and the muzzle velocity. Mounting brackets will permit quick, simple attachment of the sight in darkness. The brackets must allow repeated mounting and dismounting of sights without significant change in zero. Bore sighting may be required when weapons and sights are intermixed.	2.6	Met (para 2.6.5.1, PR, para 2.6.5.1, and para 2.2, 2.3, 2.4, and 5.1, App C, FR).

Item	Source	Criteria	Applicable Subtest	Remarks
		*Annex A has been superseded. Information from the developer indicates mounting brackets will be furnished for the following weapons: a. M14 rifle b. M60 machine gun c. M72 rocket launcher d. M79 grenade launcher e. M16A1 rifle f. M67 recoilless rifle g. M203 grenade launcher attached to the M16A1		
12	para 8d	Durability. (Essential) Sight must withstand rough handling associated with transportation and use during combat operations. Normal combat life of this item (mean time between failure not including operator maintenance requirements) will be 1,000 operating hours, 2,000 operating hours (Desirable). *** Sensor life will be at least 1,000 hours, 2,000 hours (Desirable).	2.9	Not met. The MTBF for the sight is 340 hours (para 2.9.5.5 and para 1.2, App C, FR).
13	para 8e	(Essential) The sight will be of a configuration such that it will not catch on clothing, brush, low-hanging trees, and the like.	2.8	Met (para 2.8.5.3, FR).

Item	Source	Criteria	Applicable Subtest	Remarks
14	para 8f	(Essential) The eyepiece and lens will be protected against fogging either from moisture generated by body heat or by humid conditions.	2.9	Met (para 2.9.4.6, FR).
15	para 8g	Flash and glare protection for the operator and the sights is essential. This includes protection against exposure to daylight.	2.2	Met (para 2.2.5.2, PR).
16	para h	(Essential) Item will be transportable by all means of Army transportation including a capability for air delivery (either affixed to the weapon or in an equipment bag) during Phase I of airborne operations.	2.8	Met (para 2.8.5.1, FR).
17	para i	(Essential) Power source will consist of standard expendable batteries. Minimum battery life will be such that the sight can be operated continuously for at least 12 hours without replacement. Desire that the crew served sight be capable of operating from vehicular power systems provided there is no weight penalty associated with providing this capability. A cold weather kit consisting of a pack with battery to be worn on the body for warmth and a lead wire and connector is permissible.	2.9	Met (para 2.9.5.6, PR, and para 2.9.5.6, FR).
18	para j	(Essential) Sight must withstand the shock of repeated firings without damage or change of adjustment.	2.9	Met (para 2.9.5.1, FR).

Item	Source	Criteria	Applicable Subtest	Remarks
19	para 2c	This equipment will give the combat infantryman a night fire capability which is as close to daylight capability as possible.	2.7	Met (para 2.7.5.1, PR, and para 2.7.5.9, FR).
20	para 1	(Essential) Reticle will be designed so that the sight picture for each weapon listed in Annex A* is as close as possible to the sight picture obtained with the applicable daylight sight. The reticle shall not obscure the target by side flow effects. *** (Desirable) that the reticle impose minimum drain on the power supply. A minimum number of reticle patterns is desired consistent with ballistic characteristics of the various weapons involved. See Note (*) at the end of Annex A for weapons requiring special attention.	2.6	Not met. The illuminated sight reticle is difficult to see under high ambient light conditions. The reticle sight picture is different from the day sights and require the firer to interpolate sight settings (para 2.6.5.2 and para 2.1, 2.5, 2.6, 5.2, 5.4, and 5.7, App C, FR).
21	para 8m	(Essential) Design will make provision for indications of clicks both audibly and in a manner sensitive to touch to facilitate zeroing. Zeroing procedures will be essentially the same as for standard daylight sights.	2.6, 2.11	Not met. The M16/M203 rifle-sight combination cannot be zeroed (para 2.6.5.3 and para 1.1, App C, FR).
22	para 8n	(Essential) Access to knobs or switches will be convenient from any of the normal firing positions. Adjustment will be practicable for an operator wearing gloves. Use of an adaptor kit when the operator is wearing arctic mittens (3 finger type FSC-844-160-1376) is acceptable.	2.11	Met (para 2.11.5.2, FR).
23	para 8o	(Essential) Sights will be moisture proof and dust proof.	2.9	Met (para 2.9.5.7, PR).

Item	Source	Criteria	Applicable Subtest	Remarks
24	para 8p	(Essential) Sights will be treated for fungus resistance.	2.9	Determined by the engineering test.
25	para 9a	Operator maintenance will consist of care and cleaning, minor adjustments, and changing of batteries. Other organizational maintenance will be accomplished by company armorers and will be limited to changing of modules.	2.10.1	Met (para 2.10.1.5, PR, para 2.10.1.5a and para 5.2, App C, FR).
26	para 9c	Requirements for special test equipment will be minimized insofar as possible. Maintenance characteristics will be made compatible with existing electronic test equipment, tools, and procedures.	2.10.2	Met (para 2.10.2.5a, PR, para 2.10.2.5a and para 5.3, App C, FR).
27	para 9d	Skill and time required for repair of this sight will be minimized.	2.10.4	Met (para 2.10.4.5a, FR).
28	para 9e	Weapons sight kits will include necessary tools for operator maintenance and one spare battery. If possible, the universal tool or tools issued with applicable weapon will be used.	2.10.2	Met (para 2.10.2.5b, PR, and para 2.10.2.5b and para 5.3, App C, FR).
29	para 9f	Necessary maintenance package will be provided with service test models in accordance with AR 750-1, para 2-23.	2.10.1	Met (para 2.10.1.5c, PR, and para 2.10.1.5c, FR).
30	para 9g	The following maintenance factors must be considered:		
		(1) Minimum number and complexity of maintenance tasks (i.e., calibration, adjustments, inspection).	2.10.1	Met (para 2.10.1.5d, FR).
		(2) Design for rapid and positive recognition of malfunction or marginal performance.	2.10.5	Not met (para 2.10.5.5, FR).

Item	Source	Criteria	Applicable Subtest	Remarks
30 (cont)		(3) Design for rapid and positive identification of the replaceable defective component, assembly, or part.	2.10.4	Not met.(para 2.11, App C, PR, para 2.10.4.5c and para 2.8, App C, FR).
		(4) Design to minimize maintenance personnel skills and training requirements.	2.10.5	Met (para 2.10.5.5a, PR, and para 2.10.5.5c, FR).
		(5) Design to minimize the numbers and types of tools and test equipment (special and standard) required to perform maintenance.	2.10.5	Met (para 2.10.5.5a and para 5.4, App C, FR).
		(6) Design for optimum accessibility in all systems, equipment and components requiring maintenance, inspections, removal or replacement.	2.10.5	Met (para 2.10.5.4d, FR).
		(7) Design for maximum safety and protection for both equipment and personnel involved in the performance of maintenance.	2.10.6	Met (para 2.10.6.5, PR, and para 2.10.6.5, FR).
		(8) Design to minimize the net mean time required to accomplish scheduled and unscheduled maintenance to assure operational availability.	2.10.5	Met (para 2.10.5.4e, FR).
		(9) Use modular or throw-away components, assemblies or parts where economical and practicable.	2.10.4	Met (para 2.10.4.5a, PR, and para 2.10.4.5b, FR).
		(10) Use built in testing and calibration equipment for parts and components wherever feasible.	2.10.2	Met (para 2.10.2.5c, FR).

Item	Source	Criteria	Applicable Subtest	Remarks
		(11) Design to permit accomplishment of maintenance operation in the shortest possible time under adverse working conditions.	2.10.5	Not tested.
31	para 10a	The equipment will be designed in accordance with good human factors engineering practice. The equipment will be considered as a component of a man-machine system and will be developed with full consideration for the intellectual, physical, and psychomotor capabilities of the intended user and maintenance personnel. Arrangement, size and shape of operator controls will permit ready tactile identification and adjustment in darkness. The equipment will be operable by personnel wearing arctic clothing and protective masks. Appropriate manuals detailing operating and maintenance procedures will be provided.	2.11 2.10.7 2.10.3	Met (para 2.11.5.6, PR, para 2.10.7.5, 2.10.3.5a, 2.11.5.2, and para 5.6, App C, FR).
32	para 10b	The weight and balance of the sight will be such as to minimize operator fatigue and not adversely affect the balance and other firing characteristics of the weapon.	2.7 2.11	Met (para 2.11.5.3 and 2.7.5.10, FR).
33	para 10c	Suitable methods will be developed for carrying the sight when it is not attached to the weapon. The sight case will be provided with straps or clips so that it can be carried on a fully equipped combat soldier's web equipment or over his shoulder. This will be done with minimum adverse effect to the load carrying capacity, mobility and freedom of operation of the individual soldier.	2.11	Met (para 2.11.5.4, PR, para 2.11.5.4 and para 5.5 and 5.6, App C, FR).

Item	Source	Criteria	Applicable Subtest	Remarks
34	para 12a	No additional personnel will be required for operation of this equipment.	2.4	Met (para 2.4.5.8, PR).
35	para 12b	No additional personnel will be required for first and second echelon maintenance.	2.10	Met (para 2.10.1.5b, PR).
36	para 12b	Third through fifth echelon maintenance will generate a requirement for additional personnel. The number of personnel cannot be determined until such time as maintenance characteristics are known. Applicable MOS is 356, Engineer Electronic Device Repairman.		
37	para 19	The operation of the weapon sight will not interfere with communications, surveillance, or other COMMEL equipment or vice versa. (Essential)	2.5	Met (para 2.5.5.1, PR).
38	para 13a(1)	Every basic soldier will be trained in the use of this sight during basic training. This will require approximately 2 hours of classroom work with films, TRA (GTA) charts, and mockups. An additional 8 hours of night firing on the train fire range will also be required.		
39	para 13a(3)	Maintenance Training - Each individual will receive a 1-hour lecture and a 2-hour practical exercise in first echelon maintenance to include care, cleaning, adjustment, and replacement of batteries. This same instruction will be repeated during unit training. Training for third through fifth echelon maintenance containing related skills. At unit level this training will be accomplished by practical work on a regular basis.		

Item	Source	Criteria	Applicable Subtest	Remarks
40	para 16	Cover and deception. Item will be completely passive and no more detectable at night (with reasonable precautions as far as the eyepiece is concerned) than the operator and his weapon without the sight.	2.5	Met (para 2.5.5, FR).
		B. USAIB Requirements		
41	USAIB	The test soldiers must be sufficiently trained and oriented to insure safe and proper use of the test and control items and their respective weapons.	2.3	Met (para 2.3.5.1, PR, and para 2.3.5.2, FR).
42	USAIB	Test soldiers must be sufficiently trained to properly maintain the test and control items and their respective weapons.	2.3	Met (para 2.3.5.1, PR and para 2.3.5.1, FR)
43	USAIB	The test item will be safe to operate and maintain.	2.2	Met (para 2.2.5, FR).
44	USAIB	The test and control sights and accessories will be complete and serviceable.	2.1	Met (para 2.1.5, PR, and para 2.1.5, FR).
45	USAIB	Draft or preliminary maintenance manuals provided with the test item will comply with the appropriate regulations and military standards prescribing format, content, and standards for production of technical manuals.	2.10.3	Not met (para 2.10.3.5 and para 2.7, App C, F

SECTION 2. CRITICAL ISSUES

None

APPENDIX C - DEFICIENCIES, SHORTCOMINGS, AND SUGGESTED IMPROVEMENTS

1. DEFICIENCIES

Deficiency	Suggested Corrective Action	Remarks
1.1 The M16/M203 aiming system does not properly correlate the two weapons of the M16/M203 combination weapon. The grenadier using the test sight mounted on the M203 grenade launcher is not able to use the sight in conjunction with the M16A1 rifle for close-in protection. Para 2.6.5.3b and para 2.5, App III, PR.		The day sights of the M16 and M203 portions of the weapon can be independently zeroed. The night sight uses a single reticle pattern for both weapons, thus zeroing one weapon must automatically zero the other. After a zeroing exercise, the firer set the adapter bracket range scale at 0 meters and engaged a target at 25 meters. The bullets impacted 40 inches high and 12 inches to the left.
1.2 The test sight is lacking the essential durability and reliability necessary to withstand the rough handling associated with normal operation. Para 2.9.5.5.		Four eyeguard body separations, two broken electrical terminals, and five defective image intensifier tubes. MTBF was 340 hours. The eyeguard body separation and the image intensifier tubes were uncorrected deficiencies from the Partial Report (para 1.1 and 1.4, app III, PR). The image intensifier assembly was reported in the partial report as not being sufficiently durable to withstand the shock of repeated firing. In this test (DT II), no problems were noted during firing; the five failures of image intensifier tubes occurred during usage other than weapons firing.

2. SHORTCOMINGS

Shortcoming	Suggested Corrective Action	Remarks
2.1 The illuminated sight reticle is difficult to see in bright daylight, heavy overcast daylight, bright moonlight, dawn, and dusk (para 2.6.5.2d).	Design the daylight cover to allow more light to enter the objective lens during these ambient light levels, or increase the reticle brightness accordingly.	This was reported as a deficiency in the partial report (para 1.3, app III, PR).
2.2 The M60 machine gun mounting bracket is difficult to mount (para 2.11.5.5b).	The feed tray cover pin be designed with a larger knurled knob that would allow a better grasp of the pin while being inserted and removed from the feed tray cover.	The M60 mounting bracket was difficult to mount due to difficulty in removing and replacing the feed tray cover pin.
2.3 The sight when mounted on the M60 machine gun loses its zero after the first dismounting (para 2.6.5.1a).	The tolerance between the two internal sides of the M60 bracket be reduced to prevent the bracket from moving sideways when the weapon is fired or the feed tray cover is open or closed.	The feed tray cover does not stabilize the sight well enough to retain zero after repeated mounting and dismounting.
2.4 The M203 adapter bracket range scale is not calibrated to be used in conjunction with the M16A1 portion of the weapon (para 2.6.5.1b).		This occurrence was noted during zeroing procedure by test supervisory personnel.
2.5 The reticle sight picture is different from the daylight sights of the M16A1, M14, M60, M79, and M203 (para 2.6.5.2b).		The firer is easily confused as to what sight picture to use in firing the various weapons.
2.6 The ranging dots in the reticle pattern of the M16A1, M14, and M60 require the firer to estimate ranges except at 400 and 600 meters (para 2.6.5.2c).	Use a dotted T (⊤) and zero the sight at 25 meters where the center top of the T would impact the target at 150 meters. This would eliminate interpolation of where to aim by the firer.	The sight picture is ambiguous at all ranges except 400 and 600 and confusing to the firer.

Shortcoming	Suggested Corrective Action	Remarks
2.7 The draft technical manuals are not accurate and consistent within themselves. The DTM's dealing with repair parts are poorly organized, making identification difficult (para 10.3.5b).		The two technical manuals dealing with repair parts and special tools require excessive time to determine the nomenclature and federal stock number of any given part. This was reported as a deficiency in the Partial Report, para 1.8, App III.
2.8 The sight does not permit rapid and positive identification of defective of malfunctioning components (para 2.10.4.5c).		The repairman had to either substitute known good components for suspect components or disassemble the system to make electrical checks.

3. CORRECTED DEFICIENCIES AND SHORTCOMINGS

Deficiency/Shortcoming	Corrective Action	Remarks
The alien wrench used to secure the sight to the M14 bracket is too short for its intended purpose.	Allen wrenches were replaced by longer wrenches.	The longer wrenches performed the intended purpose.

4. CORRECTED DEFICIENCIES AND SHORTCOMINGS FROM PARTIAL REPORT

Deficiency Partial Report	Corrective Action	Remarks
4.1 The range graduations on the M72A1/A2 reticle pattern do not correspond to the range graduations of the standard daylight sight (para 1.2 app III, PR).	None.	The M72A1/A2 reticle pattern posed no sight problems during the DT II (SP).
4.2 There are 41 screws on the external surface of the sight indicating poor design (para 1.6, app III, PR).	The number of external screws on the sight has been reduced.	There were no maintenance problems associated with assembly and disassembly.

Deficiency Partial Report	Corrective Action	Remarks
4.3 The sight reticle and its adjusting mechanism are not reliable (para 1.7, app III, PR).	New azimuth and elevation mechanisms. Reset reticle pattern spacing and alignment. New reticle spring contact pin.	Two failures were associated with the reticle and its adjustment mechanism as opposed to nine failures during the previous test.
4.4 The test sight is difficult to maintain (para 1.9, app III, PR).	Parts are easily changed and are componentized as much as feasible.	The operator and direct support maintenance can be performed in acceptable time and down time kept to acceptable limits.
4.5 Adjustment of azimuth and elevation adjustment mechanisms are not audible or tactile in a normal operating environment (para 1.10, app III, PR).	New azimuth and elevation mechanisms.	The azimuth and elevation adjustment mechanisms are audible and tactile in a normal operating environment.
Shortcoming Partial Report	**Corrective Action**	**Remarks**
4.6 Testing and calibration equipment is not built into the system (para 2.1, app III, PR).	None.	Although test and calibration equipment is not built into the AN/PVS-4 sight, the need for this capability was not apparent. Adequate troubleshooting procedures are provided in appropriate maintenance literature.
4.7 The sight is passive; however, it can be detected at night by personnel equipped with a metascope (para 2.2, app III, PR).	None	Detection at night can only be accomplished by personnel equipped with a metascope looking directly into the lens of the test sight. This is considered insignificant (para 2.5.4.1).
4.8 The M203 bracket locking knob would not secure the bracket on the selected range graduation (para 2.3, app III, PR).	The mounting bracket was modified to lock in place the selected range graduation range on the M203 bracket.	The bracket performs satisfactorily in a normal combat environment.

Shortcoming Partial Report	Corrective Action	Remarks
4.9 The sight brackets for the M60, M72, M79, and M203 are big and bulky and add significantly to the weight of the weapon (para 2.4, app III, PR).	The mounting brackets were all modified to correct this shortcoming.	The bracket does not add to the weight significantly nor is it big and bulky.
4.10 Twenty rounds of ammunition must be fired to stabilize the sight reticle prior to zeroing the M14/M16A1 weapon-sight combinations (para 2.6, app III, PR).	New reticle cell material. Reset reticle pattern spacing and alignment.	The weapon only requires two rounds to stabilize the sight prior to zeroing the M14/M16A1 weapon-sight combination.
4.11 There is no suitable tool for making accurate sight setting adjustments (para 2.8, app III, PR).	New azimuth and elevation control mechanisms.	Any 5.56-mm, 7.62-mm, or .50-cal cartridge case will suffice in making accurate sight adjustments.
4.12 The illuminated reticle burns the phosphor screen o the image intensifier assembly (para 2.9, app III, PR).	Different tube manufacturer (NI TEC Corp) used to start test.	No burns have been observed that could interfere with viewing area or sight reticle obscuration.
4.13 The threads on the range focusing ring are not adequate (para 2.10, app III, PR).	Coarse, double-start thread added on range focus.	The range focus ring moves freely and is easily adjusted.
4.14 The design of the sight does not take into consideration the physical characteristics of the repairmen who must maintain it (para 2.12, app III, PR).	None.	Organization and direct support personnel experienced no difficulty in maintaining or repairing the AN/PVS-4.
4.15 The amount of adjustment permitted by the design of the range focusing ring is excessive (para 2.13, app III, PR).	New focus ring installed.	The range focus ring moves approximately 1-1/2 turn, and adjustment requires the full range of motion.

5. SUGGESTED IMPROVEMENTS

Suggestion	Remarks
5.1 It is recommended that the mounting bracket knobs on all brackets be modified to prevent inadvertent removal and loss by representative operators. Para 2.6.4.2d.	After repeated incidents of knob loss.
5.2 The installation of the reticle cell be allocated to the organizational repairman. Para 2.10.1.5a.	This task does not require great skill or special tools to be accomplished.
5.3 The addition of a cross tip screwdriver, Phillips #00, to the 35E repairman tool kit when the tool kit is to be utilized in conjunction with DS maintenance repair for removal or replacement of the screws on image intensifier tube of the AN/PVS-4 night vision sight. Para 2.10.2.5d.	After experiencing some difficulty with the screws, the removal can be made easier with the Phillips #00 cross tip screwdriver.
5.4 The hole in the reticle cell used for setting the cell be redesigned as a recessed slot at the edge of the cell. Para 2.10.1.5a.	This would facilitate removal and interchange of the reticle cell.
5.5 The straps on the fabric carrying case should be lengthened. Para 2.11.5.4.	After transportability, this was observed and would make carrying easier and more secure.
5.6 The fabric bag zipper should be modified to allow the bag to be closed over the test item while the test item is mounted on a weapon. Para 2.11.4.3a.	This would give the sight better resistance against the elements and various aspects of man portability.
5.7 The ranging lines for both vehicular and personnel targets be deleted. A range line for standing personnel targets at 150 meters would be adequate. Para 2.6.5.2e.	The reticle patterns for the M14/M16A1/M60/M16A1-M203 and M79 clutter the viewing screen and provide the average soldier with information he does not need or seldom uses.
5.8 The feed tray cover pin be lengthened and the bevel on the end of the feed tray cover pin be lengthened if the present mount bracket configuration is retained. Para 2.11.5.5b.	The M60 mounting bracket was difficult to mount while wearing gloves and extremely difficult while wearing arctic mittens, due to difficulty in removing and replacing the feed tray cover pin.

APPENDIX D - MAINTENANCE EVALUATION

INSTRUCTIONS FOR MAINTENANCE ANALYSIS CHART

COLUMN

1 Group and Sequence Numbers. Functional group number as indicated in the Maintenance Allocation Chart (or TB-750-93-1) of the assembly or subassembly. The sequence number of the maintenance operation is in parentheses below the group number.

2 Component and Related Operations. Component and related operations as indicated in the Maintenance Allocation Chart. Operations assigned to depot level maintenance are not shown normally.

3 Maintenance Level, Prescribed. The maintenance level prescribed by the Maintenance Allocation Chart is indicated using the following code: C - Operator/Crew; O - Organizational; F - Direct Support; H - General Support.

4 Maintenance Level, Recommended. Use the code letters, C, O, F, or H to indicate the maintenance level recommended by the test agency.

5 TM Instructions, Adequate. An X in this column indicates the TM instructions covering this maintenance task or action are adequate.

6 TM Instructions, Inadequate. When the TM instructions are considered inadequate, insert the test agency EPR number (if appropriate) which transmitted the DA Form 2028.

7 Active Maintenance Time. Manhours and clock hours required for the maintenance operation to the nearest tenth of an hour. If the operation was not actually performed but was reviewed, the estimated active maintenance time is indicated by using the prefix E. (Unusual differences in maintenance times for the same operation should be explained in the body of the test report.)

COLUMN

8 System Life. The number of operational hours (essential) and miles, rounds, events, etc., as required in the test plan, accumulated during the test before the malfunction or scheduled service occurred. (Under the life figure, enter in parentheses the sequency number for which that particular operation was last performed followed by the appropriate life unit; i.e., M, H, R, etc.) "S" will be placed in this column if the operation was performed on a sampling basis and not because of an actual maintenance action.

9 Reason Performed. The symbol Unsched will be entered in this column if this operation was performed as a result of unscheduled maintenance. If the operation was performed and recorded as a required portion of a scheduled maintenance service, the symbol Sched will be used. If the operation was performed only to verify procedures or tool requirements, not to correct a malfunction, the symbol Sim will be entered.

NOTE. Separate maintenance and reliability analysis charts will be used to record simulated maintenance actions.

10 Remarks. When an EPR is related to a maintenance operation, the EPR number is entered. The notation, failure, indicates operations performed as a result of a failure. If the operation was not performed as a result of using the sampling technique authorized by AR 750-6, one of the following remarks, as appropriate, is entered.

a. Reviewed - not performed.

b. Neither reviewed nor performed due to (No TMs) or other reasons.

c. Other, as appropriate.

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SP. NO. (SEQ. NO.)	COMPONENT AND RELATED OPERATIONS	MAINTENANCE LEVEL S O C=OPERATOR/CREW B O=ORGANIZATION F=DIRECT I H=GENERAL D O=DEPOT			TM INSTRUCTIONS		ACTIVE MAINTENANCE TIME			SYSTEM LIFE H=HOURS M=MILES R=ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
		PRE	REC	ACT	ADQT	INADQT	CLOCK HOURS	MAN HOURS	ELAPSE HOURS				
1	2	3	4		5		6			7	8	9	10
0001 (101)	PERFORMED PEPTPST TECHNICAL INSPECTION	O	O	O	X		0.2	0.2	0.2	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
0001 (201)	OPERATIONAL MAINTENANCE PERFORMED	O	O	O	X		0.3	0.3	0.3	40.70-H 0.0 -M 0.0 -R	0.0	SCHED	
001F (301)	OPERATOR COULD NOT TURN CAPTIVE NUT ON MOUNTING BRACKET	O	O	O	X		0.1	0.1	0.1	181.50-H 0.0 -M 0.0 -R	0.0	UNSCHED	SENT SIGHT TO DS MAINTENANCE EPR KL-19
001E (302)	APPLIED FORCE TO CAPTIVE NUT CAUSING BOLT TO SHEAR	NP	NR	F	X		0.1	0.1	0.0	181.50-H 0.0 -M 0.0 -R	0.0	UNSCHED	IMPROPER MAINTENANCE PROCEDURES EPR KL-19
001F (303)	SENT BRACKET TO MACHINE SHOP WHERE THE SHEARED BOLT WAS EXTRACTED	NP	NR	F	X		0.4	0.4	0.0	181.50-H 0.0 -M 0.0 -R	0.0	UNSCHED	
001F (304)	REPLACED MOUNTING BRACKET KNOB	O	O	O	X		0.1	0.1	0.0	181.50-H 0.0 -M 0.0 -R	0.0	UNSCHED	EPR KL-19
01C1 (401)	REPLACED EYEGUARD ASSEMBLY	O	O	O	X		0.4	0.4	0.4	184.30-H 0.0 -M 0.0 -R	0.0	UNSCHED	CSE NO EPR

MAINTENANCE ANALYSIS CHART | PROJECT NO. 7-ES-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT,AN/PVS-4 | IDENTIFICATION NO. 95121 | PAGE

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	SUB ID	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADOT	INADOT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION		O	O	O	X		0.2	0.2	0.2	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
0001 (201)	OPERATIONAL MAINTENANCE PERFORMED		O	O	O	X		0.3	0.3	0.3	33.60-H 0.0 -M 0.0 -R	0.0	SCHED	
0010 (301)	REPLACED IMAGE INTENSIFIER TUBE		F	F	F	X		0.5	0.5	0.5	225.60-H 0.0 -M 0.0 -R	0.2	UNSCHED	CSF EPR KL-23 (S-1)
0010 (401)	CLEANED PARTICLES FROM THE LENS OF THE IMAGE INTENSIFIER TUBE		F	F	F	X		0.6	0.6	0.6	230.80-H 0.0 -M 0.0 -R	0.0	UNSCHED	EPR KL-26

DA FORM 4

MAINTENANCE ANALYSIS CHART | PROJECT NO. 7-FS-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT,AN/PVS-4 | IDENTIFICATION NO. 95122 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	MAINTENANCE LEVEL S U C-OPERATOR/CREW B O-ORGANIZATION F-DIRECT I H-GENERAL D D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4		5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION	U	U	U	X		0.2	0.2	0.2	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
0001 (201)	OPERATIONAL MAINTENANCE PERFORMED	U	U	U	X		0.3	0.3	0.3	33.50-H 0.0 -M 0.0 -R	0.0	SCHED	
0001R (301)	REPLACED OBJECTIVE LENS ASSEMBLY	F	F	F	X		0.5	0.5	0.5	185.40-H 0.0 -M 0.0 -R	0.1	UNSCHED	DEFECTED LENS SENT TO NVL ON 4 SEPT 1974 A SUBSTITUTE LENS WAS INSTALLED IN SIGHT. CSF EPR KL-21

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MAINTENANCE ANALYSIS CHART | PROJECT NO. 7-ES-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT, AN/PVS-4 | IDENTIFICATION NO. 95123 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	S U B I D	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT			TM INSTRUCTIONS		ACTIVE MAINTENANCE TIME			SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
			PRE	REC	ACT	ADOT	INADOT	CLOCK HOURS	MAN HOURS	ELAPSE HOURS				
1	2		3	4		5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION		0	0	0	X		0.2	0.2	0.2	0.0 -M 0.0 -M 0.0 -R	0.0	SCHED	
0001 (201)	OPERATIONAL MAINTENANCE PERFORMED		0	0	0	X		0.3	0.3	0.3	46.70-M 0.0 -M 0.0 -R	0.0	SCHED	
01A2 (301)	MOUNTING BRACKET ASSEMBLY COULD NOT BE REMOVED FROM MOUNTING ADAPTER		F	F	F	X		0.2	0.2	0.4	143.20-M 0.0 -M 0.0 -R	0.0	UNSCHED	THE SCREW THREADS WERE SHEARED OFF. EPR KL-12
01A2 (302)	REPLACED MATING ADAPTER		F	F	F	X		0.2	0.2	0.0	143.20-M 0.0 -M 0.0 -R	0.0	UNSCHED	EPR KL-12

MAINTENANCE ANALYSIS CHART | PROJECT NO. 7-ES-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT, AN/PVS-4 | IDENTIFICATION NO. 95124 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	MAINTENANCE LEVEL S U B I D: C-OPERATOR/CREW, O-ORGANIZATION, F-DIRECT, H-GENERAL, D-DEPOT			TM INSTRUCTIONS		ACTIVE MAINTENANCE TIME			SYSTEM LIFE	DIAG TIME	REASON PERFORMED	REMARKS
		PRE	REC	ACT	ADQT	INADQT	CLOCK HOURS	MAN HOURS	ELAPSE HOURS	H-HOURS M-MILES R-ROUNDS			
1	2	3		4	5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION	0	0	0	X		0.2	0.2	0.2	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
01B2 (201)	REPLACED ILLUMINATOR ASSEMBLY	F	F	F	X		0.3	0.3	0.3	0.1 -H 0.0 -M 0.0 -R	0.0	UNSCHED	CSF EPR KL-2
0001 (301)	REPLACED IMAGE INTENSIFIER TUBE STOP	F	F	F	X		0.3	0.3	0.3	7.4 -H 0.0 -M 0.0 -R	0.0	UNSCHED	KL-3
0001 (401)	OPERATIONAL MAINTENANCE PERFORMED	0	0	0	X		0.3	0.3	0.3	32.50-H 0.0 -M 0.0 -R	0.0	SCHED	
001B (501)	RETICLE PATTERN HAD DROPPED APPROXIMATELY 1/2 INCH	F	F	F	X		0.2	0.2	0.2	156.70-H 0.0 -M 0.0 -R	0.2	UNSCHED	SIGHT RETAINED AT USAIB AWAITING A REPRESENTATIVE FROM NVL. SIGHT COULD NOT BE USED AS WEAPON SIGHT BUT REMAINED IN USE AS OBSERVATION SIGHT. EPR KL-16
001B (601)	REPLACED OBJECTIVE LENS ASSEMBLY	F	F	F	X		0.5	0.5	0.5	198.20-H 0.0 -M 0.0 -R	0.0	UNSCHED	CSF EPR KL-16 (ST)
01C1 (701)	REPLACED EYE GUARD BODY	0	0	0	X		0.2	0.2	0.2	198.40-H 0.0 -M 0.0 -R	0.1	UNSCHED	DEFECTED EYE GUARD BODY SENT TO NVL. CSF EPR KL-20
001D (801)	DEFECTED INTENSIFIER TUBE	F	F	F	X		0.2	0.2	0.9	255.50-H 0.0 -M 0.0 -R	0.2	UNSCHED	SENT TO NVL FOR FAULT ANALYSIS ON 27 SEPT 1974 EPR KL-25
001D (802)	REPLACED IMAGE INTENSIFIER TUBE				X		0.7	0.7	0.0	255.50-H 0.0 -M 0.0 -R	0.0	UNSCHED	CSF EPR KL-25

MAINTENANCE ANALYSIS CHART | PROJECT NO. 7-ES-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT, AN/PVS-4 | IDENTIFICATION NO. 95125 |

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	MAINTENANCE LEVEL (S U C-OPERATOR/CREW B O-ORGANIZATION I F-DIRECT H-GENERAL D D-DEPOT) PRE	REC	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4		5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION	0	0	0	X		0.3	0.3	0.3	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
01C1 (201)	REPLACED EYESHIELD	0	0	0			0.1	0.1	0.1	30.30-H 0.0 -M 0.0 -R	0.0	SCHED	EPR KL-6
0182 (301)	SCOPE NOT OPERATIONAL	F	F	F	X		0.3	0.3	0.3	30.30-H 0.0 -M 0.0 -R	0.1	UNSCHED	DURING MAINTENANCE THE FOCUS RING WAS TURNED AND SCOPE BECAME OPERATIONAL CSF EPR KL-7
001D (401)	NO DISPLAY ON THE SCREEN	F	F	F	X		0.3	0.3	0.3	126.70-H 0.0 -M 0.0 -R	0.1	UNSCHED	DIRECT SUPPORT MAINTENANCE INSPECTED SIGHT AND FOUND IT TO BE OPERATIONAL. EPR KL-10 (5-2)
001D (501)	DEFECTED IMAGE INTENSIFIER TUBE	F	F	F	X		0.6	0.6	0.6	134.70-H 0.0 -M 0.0 -R	0.1	UNSCHED	SUBSTITUTE TUBE INSTALLED IN SIGHT AND DEFECTED TUBE MAILED TO NVL ON 7 AUGUST CSF EPR KL-10 (5-2)
01C1 (601)	EYESHIELD SEPARATED	0	0	0	X		0.1	0.1	0.1	139.90-H 0.0 -M 0.0 -R	0.0	UNSHCED	REMOVE AND REPLACED THE SAME EYESHIELD CSF EPR KL-14
001D (701)	REPLACED IMAGE INTENSIFIER TUBE	F	F	F	X		0.5	0.5	0.5	168.80-H 0.0 -M 0.0 -R	0.0	SCHED	ON 4 SEPT 1974 A REPLACEMENT IMAGE INTENSIFIER TUBE WAS RECEIVED FROM NVL EPR KL-10(S2)
01C1 (801)	EYESHIELD SEPARATED FROM RETAINING NUT	0	0	0	X		0.2	0.2	0.2	179.00-H 0.0 -M 0.0 -R	0.0	UNSCHED	REMOVED AND REPLACED THE SAME EYESHIELD CSF EPR KL-15

MAINTENANCE ANALYSIS CHART PROJECT NO. 7-FS-315-SLS-002 NOMENCLATURE NIGHT VISION SIGHT,AN/PVS-4 IDENTIFICATION NO. 95126 PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	MAINTENANCE LEVEL (S U C-OPERATOR/CREW B O-ORGANIZATION F-DIRECT I H-GENERAL D D-DEPOT) PRE	REG	ACT	TM INSTRUCTIONS ADQT	INADQT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4		5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION	O	O	O		X	0.2	0.2	0.2	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
0010 (201)	NO IMAGE ON REAR SCREEN OF IMAGE INTENSIFIER TUBE	F	F	F		X	0.2	0.2	0.4	16.20-H 0.0 -M 0.0 -R	0.2	UNSCHED	IMAGE INTENSIFIER WAS SENT TO NVL ON 12 JUNE 1974 FOR FUTHER ANALYSIS. CSF FPR KL-5
0010 (202)	REPLACED IMAGE INTENSIFIER TUBE	F	F	F		X	0.2	0.2	0.2	16.20-H 0.0 -M 0.0 -R	0.0	UNSCHED	EPR KL-5. (S1)
0001 (301)	OPERATIONAL MAINTENANCE PERFORMED	O	O	O		X	0.3	0.3	0.3	32.50-H 0.0 -M 0.0 -R	0.0	SCHED	
0101 (401)	REPLACED RETICLE ASSEMBLY	F	F	F		X	0.2	0.2	0.2	341.20-H 0.0 -M 0.0 -R	0.1	UNSCHED	CSF EPR KL-28
0182 (501)	BROKEN WIRE	F	F	F		X	0.4	0.4	0.4	410.70-H 0.0 -M 0.0 -R	0.0	UNSCHED	REPAIRED CSF KL-29

MAINTENANCE ANALYSIS CHART | PROJECT NO. 7-FS-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT, 7PVS-4 | IDENTIFICATION NO. 95127 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	SUB ID	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT			TM INSTRUCTIONS		ACTIVE MAINTENANCE TIME			SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
			PRE	REC	ACT	ADQT	INADQT	CLOCK HOURS	MAN HOURS	ELAPSE HOURS				
1	2	3	4			5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION		C	C	O	X		0.3	0.3	0.3	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
0182 (201)	REPLACED ON/OFF BRIGHTNESS CONTROL		F	F	F	X		2.1	2.1	2.1	11.60-H 0.0 -M 0.0 -R	0.0	UNSCHED	CSF EPR KL-4
0001 (301)	OPERATIONAL MAINTENANCE PERFORMED		O	O	O	X		0.3	0.3	0.3	32.70-H 0.0 -M 0.0 -R	0.0	SCHED	
0018 (401)	REPLACED IMAGE INTENSIFIER TUBE		F	F	F	X		0.5	0.5	0.5	61.50-H 0.0 -M 0.0 -R	0.0	UNSCHED	DEFECTED TUBE SENT TO NVL. CSF EPR KL-8

MAINTENANCE ANALYSIS CHART | PROJECT NO. 7-ES-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT,AN/PVS-4 | IDENTIFICATION NO. 95128 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	SUB I D	MAINTENANCE LEVEL C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADOT	INADOT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4			5		6			7	8	9	10.
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION		O	O	O	X		0.2	0.2	0.2	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
0001 (201)	OPERATIONAL MAINTENANCE PERFORMED		O	O	O	X		0.3	0.3	0.3	44.40-H 0.0 -M 0.0 -R	0.0	SCHED	
0018 (301)	THREE CRACKS IN FRONT OPTICAL LENS		F	F	F	X		0.2	0.2	0.4	108.50-H 0.0 -M 0.0 -R	0.2	UNSCHED	OBJECTIVE LENS ASSEMBLY SENT TO NVL ON 25 JULY 197 POSSIBLE HUMAN ERROR. EPR KL-9
0018 (302)	REPLACED OBJECTIVE LENS ASSEMBLY		P	P	P	X		0.2	0.2	0.0	108.50-H 0.0 -M 0.0 -R	0.0	UNSCHED	EPR KL-9 (SI)
0018 (401)	BROKEN TERMINAL ON TUBE BRIGHTNESS ON OFF SWITCH.		F	F	F	X		0.5	0.5	0.5	376.50-H 0.0 -M 0.0 -R	0.2	UNSCHED	REPAIRED BROKEN TERMINAL CSF EPR KL-27

MAINTENANCE ANALYSIS CHART | PROJECT NO. T-ES-315-SLS-002 | NOMENCLATURE NIGHT VISION SIGHT,AN/PVS-4 | IDENTIFICATION NO. 95129 | PAGE 1

GP. NO. (SEQ. NO)	COMPONENT AND RELATED OPERATIONS	MAINTENANCE LEVEL (S U B I D) C-OPERATOR/CREW O-ORGANIZATION F-DIRECT H-GENERAL D-DEPOT PRE	REC	ACT	TM INSTRUCTIONS ADOT	INADOT	ACTIVE MAINTENANCE TIME CLOCK HOURS	MAN HOURS	ELAPSE HOURS	SYSTEM LIFE H-HOURS M-MILES R-ROUNDS	DIAG TIME	REASON PERFORMED	REMARKS
1	2	3	4		5		6			7	8	9	10
0001 (101)	PERFORMED PRETEST TECHNICAL INSPECTION	O	O	O		X	0.2	0.2	0.2	0.0 -H 0.0 -M 0.0 -R	0.0	SCHED	
0001 (201)	OPERATIONAL MAINTENANCE PERFORMED	O	O	O		X	0.3	0.3	0.3	32.50-H 0.0 -M 0.0 -R	0.0	SCHED	

INSTRUCTIONS FOR PARTS ANALYSIS CHART

General. The Parts Analysis Chart provides for a listing of the parts used in maintaining the test item. Parts will be grouped on this chart by functional group and in Federal Stock Number (FSN) numerical order within each group.

COLUMN

1 Group and Sequence Number. Parts usage by maintenance operation is indicated by a cross reference to the group number and sequence number from Column 1 of the Maintenance Analysis Chart.

2 Federal Stock Number. Record the Federal Stock Number, Technical Service Part Number, Manufacturers' Part Number, or Drawing Number in this order of preference.

3 Noun Nomenclature. As listed in the parts manual.

4 Maintenance Level, Prescribed. The Maintenance Level prescribed by the parts list under review. Use the code: C - Operator/Crew; O - Organizational; F - Direct Support; H - General Support.

5 Maintenance Level, Recommended. The code symbols, C, O, F, or H indicate the maintenance level recommended by the test agency.

6 Part Life. The number of operating hours (essential) and miles, rounds, events, etc., as required by the test plan, accumulated by this part. This is Actual Part Life and should agree with the part life reported on the EPR. Each entry in this column is followed by the appropriate life unit symbol; i.e., H, M, or R, etc.

7 Reason Used. The symbol Unsched will be entered in this column if this part was used as a result of unscheduled maintenance. If the part was replaced as a required action of scheduled maintenance, the symbol Sched will be entered. If the part was used as a "time change component," the symbol TCC will be entered. If the part was consumed to verify procedures or tools, not to correct a malfunction, the symbol Sim will be entered.

COLUMN

8 Remarks. If an EPR is related to the part used, the EPR reference number will be inserted in this column. When the part was replaced to correct a failure, as defined in this regulation, it will be indicated by inserting the word Failure in this column.

PARTS ANALYSIS CHART		PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 120
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1C1 (101)	501-2690-401 (1 ea)	Eyeguard Assy	0	0	200.7 H	Unsched	Charge Failure No EPR.

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(USATECOM Reg 750-15)

PARTS ANALYSIS CHART		PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 121
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1A2 (101)	5305-455-2549 (1 ea)	Screw	F	F	0-H	Sched	Pre Inspection.
2D (201)	SM-D-850310 (1 ea)	Tube, Image Intensifier	F	F	225.5-H	Unsched	Failure -EPR-23 KL(5-3)

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4 Jan 71

(USATECOM Reg 750-15)

PARTS ANALYSIS CHART	PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 122
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1B (101)	501-2603-401 (1 ea)	Objective Assy.	F	F	185.4-H	Unsched	Failure - EPR KL-21

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(USATECOM Reg 750-15)

PARTS ANALYSIS CHART	PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 124
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1A2 (101)	5305-455-2549 (1 ea)	Screw	F	F	0-H	Sched	Pre Inspection
1B2 (201)	MFA Code 305-023 (1 ea)	Illuminator, Assembly	F	F	.1-H	Unsched	Failure - EPR KL-2
1D (301)	LCI-150-10 (1 ea)	Block, Tube Stop	F	F	7.3-H	Sched	Non-charge Failure - EPR KL-3
1D (302)	MS51957-11 (1 ea)	Set Screw, Socket	F	F	7.3-H	Sched	Non-charge Failure - EPR KL-3
1B (401)	501-2603-401 (1 ea)	Objective, Assy	F	F	156.5-H	Unsched	Failure - EPR KL-16
1C1 (501)	501-2690-401 (1 ea)	Eyeguard Assy	0	0	198.4-H	Unsched	Failure - EPR KL-20 (6-3)
1D (601)	SM-D-850310 (1 ea)	Tube, Image Intensifier	F	F	255.5-H	Unsched	Failure - EPR KL-25 (5-4)

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(USATECOM Reg 750-15)

PARTS ANALYSIS CHART	PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 125
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1C1 (101)	501-2690-401 (1 ea)	Eyeguard, Assy	0	0	30.2-H	Sched	Non-charge Failure - EPR KL-6
1D (201)	SM-D-850310 (1 ea)	Tube, Image Intensifier	F	F	134.5-H	Unsched	Failure - EPR KL-10 (5-2)
1C1 (301)	501-2690-401 (1 ea)	Eyeguard, Assy	0	0	109.7-H	Unsched	Chargeable Failure - EPR KL-14 (6-1)
1C1 (401)	501-2690-401 (1 ea)	Eyeguard Assy	0	0	39.1-H	Unsched	Chargeable Failure - EPR KL-15 (6-2)

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PARTS ANALYSIS CHART		PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 126
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESD	RECM			
1	2	3	4	5	6	7	8
1D (101)	SM-D-850310 (1 ea)	Tube, Image Intensifer	F	F	16.2-H	Unsched	Failure EPR KL-5(51)

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PARTS ANALYSIS CHART		PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 127
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1A2 (101)	328-0023-013 (1 ea)	Resistor, Variable	F	F	11.6-H	Usched	Failure - EPR KL-4
1D (201)	SM-D-850310 (1 ea)	Tube, Image Intensifer	F	F	61.5-H	Unsched	Failure - EPR KL-8(5-1)

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PARTS ANALYSIS CHART		PROJECT NO	NOMENCLATURE				IDENTIFICATION NO 128
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1B (101)	501-2603-401 (1 ea)	Objective Assembly	F	F	108.5-H	Unsched	Noncharge Failure - EPR KL-9(51)

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(USATECOM Reg 750-15)

PARTS ANALYSIS CHART		PROJECT NO	NOMENCLATURE RETICLE ASSEMBLY				IDENTIFICATION NO 126
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
1B1	501-2876-401 (1 ea)	Reticle Assembly M-16	F	O	N/A	Unsched	Charge Failure EPR KL-28

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PARTS ANALYSIS CHART	PROJECT NO	NOMENCLATURE ALL MOUNTING BRACKETS				IDENTIFICATION NO
GP NO (SEQ NO)	FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL C -OPERATOR/CREW O -ORG F -DIRECT H -GENERAL		PART LIFE H - HOURS M - MILES R - ROUNDS	REASON USED	REMARKS
			PRESB	RECM			
1	2	3	4	5	6	7	8
BRACKET ASSEMBLIES							
M-14	501-3004-301 (1 ea)	Screw, Socket Head	F	O	N/A	Unsched	Nonchargeable Failure EPR KL-11
	5310-812-3378 (1 ea)	Washer, Lock	F	O	N/A	Unsched	Nonchargeable Failure EPR KL-11
M-79	501-3007-305 (1 ea)	Knob	F	O	N/A	Unsched	Nonchargeable Failure EPR KL-12
	501-3042-401 (1 ea)	Bracket, Elevation	F	O	N/A	Unsched	Nonchargeable Failure EPR KL-12
M-60		Evaluate to NVL 2 each bracket				Unsched	Nonchargeable Failure EPR KL-13(S1)
M-72	501-3007-301 (1 ea)	Knob	F	O	N/A	Unsched	Nonchargeable Failure EPR KL-19
M-72	501-3013-301 (1 ea)	Screw, Shoulder	F	O	N/A	Unsched	Nonchargeable Failure EPR KL-24

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INSTRUCTIONS FOR
MAINTENANCE PACKAGE LITERATURE CHART

COLUMN

1	Enter Army or manufacturer's publication or draft manual number.
2	Number of copies received. Insert "0" if none were supplied. Use Chapter 9, AR 310-3, as a guide to determine those publications that should accompany the test item. Publications contained in the maintenance test package should cover operations and functions through general support maintenance and should specify the categories involved.
3	Complete Title.
4	Enter date publication was received.
5	Enter date test item or materiel was received.
6 & 7	Insert "X" in appropriate block. Minor errors noted on DA Form 2028 are not in themselves sufficient reasons to term a publication inadequate.
8	Insert EPR number (if appropriate) and date DA Form 2028 was forwarded.
9	In addition to appropriate remarks, explain if manuscript was not evaluated and the reason therefor.

MAINTENANCE PACKAGE LITERATURE CHART PROJECT NO NOMENCLATURE Night Vision Sight AN/PVS-4

MANUSCRIPT			DATE RECEIVED		EVALUATION		DA FORM 2028	
NUMBER	QTY	TITLE	LIT	MTL	ADQ	INAD	DATE F'WDED	REMARKS
1	2	3	4	5	6	7	8	9
DTM-5855-213-12	4	Draft Operator and Organizational Maintenance Manual for Night Vision Sight, Individual Served Weapons AN/PVS-4 ( ) (V).	Jun 74	Jun 74		X	19 Nov 74	See DA Form 2028 attached to EPR-30
DTM-5855-213-20P	2	Repair Parts and Special Tools List for Organizational Maintenance for Night Vision Sight, Individual Served Weapons. AN/PVS-4 ( ) (V)	Jun 74	Jun 74	X			
DTM-5855-213-34	3	Direct and General Support Maintenance Manual for Night Vision Sight, Individual Served Weapons. AN/PVS-4 ( ) (V)	Jun 74	Jun 74		X	19 Nov 74	See DA Form 2028 attached to EPR-32
DTM-5855-213-34P	3	Repair Parts and Special Tools List for Direct Support and General Support Maintenance (Including Depot Overhaul Parts) for Night Vision Sight, Individual Served Weapons. AN/PVS-4 ( ) (V)	Jun 74	Jun 74		X	19 Nov 74	See DA Form 2028 attached to EPR-31

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INSTRUCTIONS FOR
SPECIAL TOOL AND TEST EQUIPMENT CHART

COLUMN

1 Nomenclature or Description. Enter the nomenclature as shown in the manual or if none, enter noun nomenclature and brief description of item. (Enter in parentheses the number of like items received, such as "(2 ea)".)

2 Federal Stock Number or Part Number. Enter one of the following -- Federal Stock Number, Part Number or Drawing Number, in this order.

3 Maintenance Level, Prescribed. Maintenance level authorized the special tool as prescribed by the technical publication.

4 Maintenance Level, Recommended. Indicate the maintenance level to be authorized the special tool as recommended by test agency. If the tool is not required, enter none.

5 Date Received. Enter the date the special tool or test equipment was received (Example 6/69). Enter not rec if the special tool or test equipment was not received.

6 Evaluation, Adequate. Enter an X if the tool was found to be adequate for use by the mechanics and for its intended purpose at the maintenance level recommended in Column 4. Make no comment on tools marked None in Column 4.

7 Evaluation, Inadequate. Enter an X if the special tool was found to be inadequate for its intended use. Make no comment on tools marked None in Column 4.

8 Required (ROR) Yes or No. A yes in this column indicates the special tool or test equipment is required at the maintenance level indicated in Column 4. A No in this column indicates the special tool or test equipment is not required. This column should be marked No when None is marked in Column 4.

9 Listed in Technical Manual. Enter the number of the technical publication for the test item in which the special tool or test equipment is listed.

COLUMN

10 Remarks. If an EPR is related to the special tool, the EPR number will be entered. If the special tool or test equipment was used only to verify the need for the item, this will be indicated. When it has been determined that a special tool is not required, indicate the tool from the common tool set and the set number which will perform the required maintenance function.

SPECIAL TOOLS AND TEST EQUIPMENT CHART	PROJECT NO 3313				NOMENCLATURE Night Vision Sight AN/PVS-4 ( ) (V)				
NOMENCLATURE OR DESCRIPTION	FSN OR PART NO	MAINT LVL C-OP/CREW O-ORG F-DIRECT H-GENERAL		DATE RECD	EVALUATION		RQR YES OR NO	TECHNICAL MANUAL IN WHICH LISTED	REMARKS
		PRES	RECM		ADQ	INAD			
1	2	3	4	5	6	7	8	9	10
NONE	----								

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APPENDIX G - ABBREVIATIONS

A_a - Achieved Availability

A_i - Inherent Availability

A_o - Operational Availability

COMMEL - communication/electronic

$\dot{M}$ - Mean active maintenance downtime

M - Maintainability

MDT - Mean downtime

M14 - Rifle, 7.62-mm, M14

M16 - Rifle, 5.56-mm, M16A1

M203 - Grenade launcher, 40-mm, M203

M60 - Machine gun, M60

M67 - Recoilless rifle, M67

M72 - Rocket launcher, M72A1

M79 - Grenade launcher, 40-mm, M79

MR - Maintenance ratio

NVL - Night Vision Laboratory

RR - Recoilless rifle

SI - Single individual

SI (EN) - Single individual (enemy)

TECOM - US Army Test and Evaluation Command

TRA - Training aid

USAACEBD - US Army Airborne, Communications, and Electronics Board

APPENDIX H - DISTRIBUTION LIST

Addressee	No. Copies
	70
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Commander US Army Materiel Command ATTN: AMCRD-O AMCRD-U AMCRD-R AMCMA AMCQA AMCSF 5001 Eisenhower Avenue Alexandria, VA 22333	 3 1 1 1 1 1
Director Night Vision Laboratory ATTN: AMSEL-NV-SE Fort Belvoir, VA 22060	5
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Assistant Commandant US Army Infantry School ATTN: ATSH-CD Fort Benning, GA 31905	3
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Commander US Army Tropic Test Center Fort Clayton, CZ	1

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Commander Aberdeen Proving Ground ATTN: STEAP-MT STEAP-TL Aberdeen Proving Ground, MD 21005	 1 1
President US Army Infantry Board Fort Benning, GA 31905	10